THE

ANIMAL KINGDOM

ARRANGED AFTER ITS ORGANIZATION,

FORMING A NATURAL HISTORY OF ANIMALS,

AND

AN INTRODUCTION TO COMPARATIVE ANATOMY.

BY

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WITH CONSIDERABLE ADDITIONS BY

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PREFACE.

PERHAPS no book was ever so soon, so generally, and with so little envy, admitted to take its place at the head of that department of knowledge to which it belongs, as the REGNE ANIMAL of the illustrious Baron Cuvier. This is a high, but a just tribute, both to the work and the author; for it at once showed that the former is what had long been required, and that the latter was as much admired for the comprehensive range and unprecedented accuracy of his views, as he was beloved for the kindness and urbanity of his manners.

It must, indeed, be admitted, that, until Cuvier's great work made its appearance, we had no modern systematic arrangement of animals which applied equally to all the Classes, Orders, and Families;—which brought the extinct species into their proper situations in the living catalogue, and enabled every discoverer of a new animal, or part of an animal, instantly to connect it with its proper tribe or family. Important, however, as are the labours of this great naturalist, they could not possibly extend beyond the limits of what was known; and as Cuvier was no speculative theorist, but a rigid adherent to nature and fact, he kept his system considerably within the limits of those who were more speculative, and consequently less accurate.

For students, no work is equal to that of Cuvier, for it is at once comprehensive and concise; and though the student may choose a particular department, and require books more in detail with reference to that department, he must still have the REGNE ANIMAL to point out to him the general analogies of the living creation. The present work is a complete Cuvier, as regards the essential part of the arrangement; and it is not a mere translation, but in some respects a new book, embodying the original one.

The translations of the respective divisions of the work, and their adaptations to the advanced state of science, have been executed by the undernoted gentlemen, viz.:—

THE MAMMALIA, BIRDS, AND REPTILES. By Edward Blyth, Esq.
THE FISHES AND RADIATA. By Robert Mudie, Esq.
THE MOLLUSCOUS ANIMALS. By George Johnston, Esq., M.D.
THE ARTICULATED ANIMALS. By J. O. Westwood, Esq., F.L.S.

Throughout the whole of these departments there will be found original remarks; but these are always distinguished from that which belongs to Cuvier, by being enclosed within brackets. This mode of arrangement was thought to be much better than the appending of notes, which always divide the attention of the reader, and weaken the interest of the subject. Many of the classes and orders have been reinvestigated, and many new species added. This is most extensively done in the departments which were intrusted to Mr. BLYTH and Mr. WESTWOOD; but it runs more or less throughout the whole; and the publishers flatter themselves that this will be of great service to all students of this highly interesting branch of knowledge. The different sizes of type, which bear some proportion to the comparative importance of the subject, will enable the reader to glean an outline of the system;—to obtain something more than a bare outline, he must read the entire work.

To these remarks, which were appended in 1846 to the first edition, the publishers may be permitted to add a few words respecting the present reprint. It was not considered desirable to disturb the illustrious author's arrangement by the introduction of a more modern system, nor was it thought proper to overlook altogether, in a work professing to give a complete view of Animated Nature, the results of modern investigation. The publishers have, therefore, added supplementary articles to such branches as seemed to require it; Dr. CARPENTER kindly supplying what was wanting to the Mollusca and Fishes, and Mr. WESTWOOD performing the same to his own department of the work.

In addition to these improvements, the work is now illustrated by thirty plates of Animals, etched by Mr. THOMAS LANDSEER, and four plates representing the different races of Mankind; and the publishers present it in its present form in the belief that it will merit public approbation.

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THE

AUTHOR'S PREFACES.

PREFACE TO THE FIRST EDITION.

HAVING been devoted, from my earliest youth, to the study of comparative anatomy, that is to say of the laws of the organization of animals, and of the modifications which this organization undergoes in the various species, and having, for nearly thirty years past, consecrated to that science every moment of which my duties allowed me to dispose, the constant aim of my labours has been to reduce it to general rules, and to propositions that should contain their most simple expression. My first essays soon led me to perceive that I could only attain this object in proportion as the animals, whose structure I should have to elucidate, were arranged in conformity with that structure, so that under one single name, of class, order, genus, &c., might be embraced all those species which, in their internal as well as exterior conformation, present accordancies either more general or more particular. Now this is what the greater number of naturalists of that epoch had never sought to effect, and what but few of them could have achieved, even had they been willing to try; since a parallel arrangement presupposes a very extensive knowledge of the structures, of which it ought, in some measure, to be the representation.

It is true that Daubenton and Camper had supplied facts,—that Pallas had indicated views; but the ideas of these well-informed men had not yet exercised upon their contemporaries the influence which they merited. The only general catalogue of animals then in existence, and the only one we possess even now,—the system of Linnæus,—had just been disfigured by an unfortunate editor, who did not so much as take the trouble to comprehend the principles of that ingenious classifier, and who, wherever he found any disorder, seems to have tried to render it more inextricable.

It is also true that there were very extensive works upon particular classes, which had made known a vast number of new species; but their authors barely considered the external relations of those species, and no one had employed himself in co-arranging the classes and orders according to their entire structure: the characters of several classes remained false or incomplete, even in justly celebrated anatomical works; some of the orders were arbitrary; and in scarcely any of these divisions were the genera approximated conformably to nature.

I was necessitated then,— and the task occupied considerable time,— I was compelled to make anatomy and zoology, dissection and classification, proceed beforehand; to seek, in my first remarks on organization, for better principles of distribution; to employ these, in order to arrive at new remarks; and in their turn the latter, to carry the principles of distribution to perfection: in fine, to elicit from the mutual reaction of the two sciences upon each other, a system of zoology adapted to serve as an introduction and a guide in anatomical researches, and a body of anatomical doctrine fitted to develope and explain the zoological system.

The first results of this double labour appeared in 1795, in a special memoir upon a new division of the white-blooded animals. A sketch of their application to genera, and to the division of these into sub-genera, formed the object of my *Tableau Élémentaire des Animaux*, printed in 1798, and I improved this work, with the assistance of M. Dumeril, in the tables annexed to the first volume of my *Leçons d'Anatomie Comparée*, in 1800.

I should, perhaps, have contented myself with perfecting these tables, and proceeded immediately to the publication of my great work on anatomy, if, in the course of my researches, I had not been frequently struck with another defect of the greater number of the general or partial systems of zoology; I mean, the confusion in which the want of critical precision had left a vast number of species, and even many genera.

Not only were the classes and orders not sufficiently conformed to the intrinsical nature of animals, to serve conveniently as the basis to a treatise on comparative anatomy, but the genera themselves, though ordinarily better constituted, offered but inadequate resources in their nomenclature, on account of the species not having been arranged under each of them, conformably to their characters. Thus, in placing the Manati in the genus Morse, the Siren in that of the Eels, Gmelin had rendered any general proposition relative to the organization of these genera impossible; just as by approximating in the same class and in the same order, and placing side by side, the Cuttle and the fresh-water Polypus, he had made it impossible to predicate anything generally of the class and order which comprised such incongruous beings.

I select the above examples from among the most prominent; but there existed an infinitude of such mistakes, less obvious at the first glance, which occasioned inconveniences not less real.

It was not sufficient, then, to have imagined a new distribution of the classes and orders, and to have properly placed the genera; it was also necessary to examine all the species, in order to be assured that they really belonged to the genera in which they had been placed.

Having come to this, I found not only species grouped or dispersed contrary to all reason, but I remarked that many had not been established in a positive manner, either by the characters which had been assigned to them, or by their figures and descriptions. Here one of them, by means of synonymes, represents several under a single name, and often so different that they should not rank in the same genus: there a single one is doubled, tripled, and successively reappears in several sub-genera, genera, and sometimes different orders.

What can be said, for example, of the *Trichechus manatus* of Gmelin, which, under a single specific name, comprehends three species and two genera,—two genera differing in almost everything? By what name shall we speak of the *Velella*, which figures

twice among the *Medusæ* and once among the *Holothuriæ?* How are we to reassemble the *Biphoræ*, of which some are there called *Dagysa*, the greater number *Salpa*, while several are ranged among the *Holothuriæ?*

It did not therefore suffice, in order completely to attain the object aimed at, to review the species: it was necessary to examine their synonymes; or, in other words, to re-model the system of animals.

Such an enterprize, from the prodigious developement of the science of late years, could not have been executed completely by any one individual, even granting him the longest life, and no other occupation. Had I been constrained to depend upon myself alone, I should not have been able to prepare even the simple sketch which I now give; but the resources of my position seemed to me to supply what I wanted both of time and talent. Living in the midst of so many able naturalists, drawing from their works as fast as they appeared, freely enjoying the use of the collections they had made, and having myself formed a very considerable one, expressly appropriated to my object, a great part of my labour consisted merely in the employment of so many rich materials. It was not possible, for instance, that much remained for me to do on shells, studied by M. de Lamarck, nor on quadrupeds, described by M. Geoffroy. The numerous and new affinities described by M. de Lacepède, were so many data for my system of fishes. M. Levaillant, among so many beautiful birds collected from all parts, perceived details of organization which I immediately adapted to my plan. My own researches, employed and fructified by other naturalists, yielded results to me which, in my hands alone, they would not all have produced. So, also, M. de Blainville and M. Oppel, in examining the cabinet which I had formed of anatomical preparations on which I designed to found my divisions of reptiles, anticipated—and perhaps better than I should have done—results of which as yet I had but a glimpse, &c., &c.

Encouraged by these reflections, I determined to precede my Treatise on Comparative Anatomy by a kind of abridged system of animals, in which I should present their divisions and subdivisions of all degrees, established in a parallel manner upon their structure, both internal and external; where I would give the indication of well-authenticated species that belonged, with certainty, to each of the subdivisions; and where, to create more interest, I would enter into some details upon such of the species as, from their abundance in our country, the services which they render us, the damage which they occasion to us, the singularity of their manners and economy, their extraordinary forms, their beauty, or their magnitude, are the most remarkable.

I hoped by so doing to prove useful to young naturalists, who, for the most part, have but little idea of the confusion and errors of criticism in which the most accredited works abound, and who, particularly in foreign countries, do not sufficiently attend to the study of the true relations of the conformation of beings: I considered myself as rendering a more direct service to those anatomists, who require to know beforehand to which orders they should direct their researches, when they wish to solve by comparative anatomy some problem of human anatomy or physiology, but whose ordinary occupations do not sufficiently prepare them for fulfilling this condition, which is essential to their success.

Nevertheless, I have not professed to extend this twofold view equally to all classes of the animal kingdom; and the vertebrated animals, as in every sense the most in-

teresting, claimed to have the preference. Among the *Invertebrata,* I have had more particularly to study the naked mollusks and the great zoophytes ; but the innumerable variations of the external forms of shells and corals, the microscopic animals, and the other families which perform a less obvious office in the economy of nature, or whose organization affords but little room for the exercise of the scalpel, did not require to be treated with the same detail. Independently of which, so far as the shells and corals are concerned, I could depend on a work just published by M. de Lamarck, in which will be found all that the most ardent desire for information can require.

With respect to insects, so interesting by their external forms, their organization, habits, and by their influence on all living nature, I have had the good fortune to find assistance which, in rendering my work infinitely more perfect than it could have been had it emanated solely from my pen, has, at the same time, greatly accelerated its publication. My colleague and friend, M. Latreille, who has studied these animals more profoundly than any other man in Europe, has kindly consented to give, in a single volume, and nearly in the order adopted for the other parts, a summary of his immense researches, and an abridged description of those innumerable genera which entomologists are continually establishing.

As for the rest, if in some instances I have given less extent to the exposition of sub-genera and species, this inequality has not occurred in aught that concerns the superior divisions and the indications of affinities, which I have every where founded on equally solid bases, established by equally assiduous researches.

I have examined, one by one, all the species of which I could procure specimens ; I have approximated those which merely differed from each other in size, colour, or in the number of some less important parts, and have formed them into what I designate a sub-genus.

Whenever it was possible, I have dissected at least one species of each sub-genus ; and if those be excepted to which the scalpel cannot be applied, there exists in my work but very few groups of this degree, of which I cannot produce some considerable portion of the organs.

After having determined the names of the species which I had examined, and which had previously been either well figured or well described, I placed in the same sub-genera those which I had not seen, but whose exact figures, or descriptions, sufficiently precise to leave no doubt of their natural relations, I found in authors ; but I have passed over in silence that great number of vague indications, on which, in my opinion, naturalists have been too eager to establish species, the adoption of which has mainly contributed to introduce into the catalogue of beings, that confusion which deprives it of so much of its utility.

I could have added, almost every where, a vast number of new species ; but as I could not refer to figures, it would have been incumbent on me to extend their descriptions beyond what space permitted : I have, therefore, preferred depriving my work of this ornament, and have only indicated those, the peculiar conformation of which gives rise to new sub-genera.

My sub-genera once established on positive relations, and composed of well-authenticated species, it remained only to construct this great scaffolding of genera, tribes, families, orders, classes, and primary divisions, which constitute the entire animal kingdom.

In this I have proceeded, partly by ascending from the inferior to the superior divisions, by means of approximation and comparison; and partly also by descending from the superior to the inferior groups, on the principle of the subordination of characters; comparing carefully the results of the two methods, verifying one by the other, and always sedulously establishing the correspondence of external and internal structure, which, the one as well as the other, are integral parts of the essence of each animal.

Such has been my procedure whenever it was necessary and possible to introduce new arrangements; but I need not observe that, in very many places, the results to which it would have conducted me had already been so satisfactorily obtained, that I had only to follow the track of my predecessors. Notwithstanding which, even in those cases where no alteration was required, I have verified and confirmed, by new observations, what was previously acknowledged, and what I did not adopt until it had been subjected to a rigorous scrutiny.

The public may form some idea of this mode of examination, from the memoirs on the anatomy of mollusks, which have appeared in the *Annales du Museum*, and of which I am now preparing a separate and augmented collection. I venture to assure the reader that I have bestowed quite as extensive labour upon the vertebrated animals, the annelides, the zoophytes, and on many of the insects and crustaceans. I have not deemed it necessary to publish it with the same detail; but all my preparations are exposed in the Cabinet of Comparative Anatomy in the Jardin du Roi, and will serve hereafter for my treatise on anatomy.

Another very considerable labour, but the details of which cannot be so readily authenticated, is the critical examination of species. I have verified all the figures alleged by different authors, and as often as possible referred each to its true species, previously to selecting those which I have indicated: it is entirely from this verification, and never from the classification of preceding systematists, that I have referred to my sub-genera the species that belong to them. Such is the reason why no astonishment should be experienced on finding that such and such a genus of Gmelin is now divided, and distributed even in different classes and still higher divisions; that numerous nominal species are reduced to a single one, and that popular names are very differently applied. There is not one of these changes which I am not prepared to justify, and of which the reader himself may not obtain the proof, by recurring to the sources which I have indicated.

In order to lessen his trouble, I have been careful to select for each class a principal author, generally the richest in good original figures; and I quoted secondary works only where the former are deficient, or where it was useful to establish some comparison, for the sake of confirming synonymes.

My subject could have been made to fill many volumes; but I considered it my duty to condense it, by imagining abridged means of expression. These I have obtained by graduated generalities. By never repeating for a species that which might be said of an entire sub-genus, nor for a genus what might be applied to a whole order, and so on, we arrive at the greatest economy of words. To this my endeavours have been, above all, particularly directed, inasmuch as it was the principal end of my work. It may be remarked, however, that I have not employed many technical terms, and that I have endeavoured to communicate my ideas without that barbarous array of fictitious words, which, in the works of so many of our natural historians are

so very repulsive. I cannot perceive, however, that I have thereby lost any thing in precision or clearness.

I have been compelled, unfortunately, to introduce many new names, although I have endeavoured, as far as possible, to preserve those of my predecessors; but the numerous sub-genera I have established required these denominations; for in things so various, the memory is not satisfied with numerical indications. I have selected them, so as either to convey some character, or among the common names which I have latinized, or lastly, after the example of Linnæus, from among those of mythology, which are generally agreeable to the ear, and which we are far from having exhausted.

In naming species, however, I would nevertheless recommend employing the substantive of the genus, and the trivial name only. The names of the sub-genera are designed merely as a relief to the memory, when we would indicate these subdivisions in particular. Otherwise, as the sub-genera, already very numerous, will in the end become greatly multiplied, in consequence of having substantives continually to retain, we shall be in danger of losing the advantages of that binary nomenclature so happily imagined by Linnæus.

It is the better to preserve it that I have dismembered as little as possible the great genera of that illustrious reformer of science. Whenever the sub-genera into which I divide them were not to be translated into different families, I have left them together under their former generic appellation. This was not only due to the memory of Linnæus, but was necessary in order to preserve the mutual intelligence of the naturalists of different countries.

To facilitate still more the study of this work,—for it is to be studied more than to be glanced over,—I have employed different-sized types in the printing of it, to correspond to the different grades of generalization of the statements contained in it. * * * Thus the eye will distinguish beforehand the relative importance of each group, and the order of each successive idea; and the printer will second the author with every contrivance which his art supplies, that may conduce to assist the memory.

The habit, necessarily acquired in the study of natural history, of mentally classifying a great number of ideas, is one of the advantages of this science, which is seldom spoken of, and which, when it shall have been generally introduced into the system of common education, will perhaps become the principal one: it exercises the student in that part of logic which is termed method, as the study of geometry does in that which is called syllogism, because natural history is the science which requires the most precise methods, as geometry is that which demands the most rigorous reasoning. Now this art of method, when once well acquired, may be applied with infinite advantage to studies the most foreign to natural history. Every discussion which supposes a classification of facts, every research which requires a distribution of matters is performed after the same manner; and he who had cultivated this science merely for amusement, is surprised at the facilities it affords for disentangling all kinds of affairs.

It is not less useful in solitude. Sufficiently extensive to satisfy the most powerful mind, sufficiently various and interesting to calm the most agitated soul, it consoles the unhappy, and tends to allay enmity and hatred. Once elevated to the contemplation of that harmony of Nature irresistibly regulated by Providence, how weak and

trivial appear those causes which it has been pleased to leave dependent on the will of man! How astonishing to behold so many fine minds, consuming themselves, so uselessly for their own happiness and that of others, in the pursuit of vain combinations, the very traces of which a few years suffice to obliterate!

I avow it proudly, these ideas have been always present to my mind,—the companions of my labours; and if I have endeavoured by every means in my power to advance this peaceful study, it is because, in my opinion, it is more capable than any other of supplying that want of occupation, which has so largely contributed to the troubles of our age;—but I must return to my subject.

There yet remains the task of accounting for the principal changes I have effected in the latest received methods, and to acknowledge the amount of obligation to those naturalists, whose works have furnished or suggested a part of them.

To anticipate a remark which will naturally occur to many, I must observe that I have neither pretended nor desired to class animals so as to form a single line, or as to mark their relative superiority. I even consider every attempt of this kind impracticable. Thus, I do not mean that the mammalia or birds which come last, are the most imperfect of their class; still less do I intend that the last of mammalia are more perfect than the first of birds, or the last of mollusks more perfect than the first of the annelides, or zoophytes; even restricting the meaning of this vague word *perfect* to that of "most completely organized." I regard my divisions and subdivisions as the merely graduated expression of the resemblance of the beings which enter into each of them; and although in some we observe a sort of passage or gradation from one species into another, which cannot be denied, this disposition is far from being general. The pretended chain of beings, as applied to the whole creation, is but an erroneous application of those partial observations, which are only true when confined to the limits within which they were made; and, in my opinion, it has proved more detrimental to the progress of natural history in modern times, than is easy to imagine.

It is in conformity with these views, that I have established my four principal divisions, which have already been made known in a separate memoir. I still think that it expresses the real relations of animals more exactly than the old arrangement of *Vertebrata* and *Invertebrata*, for the simple reason, that the former animals have a much greater mutual resemblance than the latter, and that it was necessary to mark this difference in the extent of their relations.

M. Virey, in an article of the *Nouveau Dictionnaire d'Histoire Naturelle*, had already discerned in part the basis of the division, and principally that which reposes on the nervous system.

The particular approximation of oviparous Vertebrata, inter se, originated from the curious observations of M. Geoffroy on the composition of bony heads, and from those which I have added to them relative to the rest of the skeleton, and to the muscles.

In the class of Mammalia, I have brought back the *Solipedes* to the *Pachydermata*, and have divided the latter into families on a new plan; the *Ruminantia* I have placed at the end of the quadrupeds; and the Manati near the *Cetacea*. The distribution of the *Carnaria* I have somewhat altered; the Oustitis have been wholly separated from the Monkeys, and a sort of parallelism indicated between the *Marsupiata* and other digitated quadrupeds, the whole from my own anatomical researches. All that I hav-

given on the *Quadrumana* and the Bats is based on the recent and profound labours of my friend and colleague M. Geoffroy de St. Hilaire. The researches of my brother, M. Frederic Cuvier, on the teeth of the *Carnaria* and *Rodentia*, have proved highly useful to me in forming the sub-genera of these two orders. Notwithstanding the genera of the late M. Illiger are but the results of these same studies, and of those of some foreign naturalists, I have adopted his names whenever his genera corresponded with my sub-genera. M. de Lacepède has also discerned and indicated many excellent divisions of this degree, which I have been equally compelled to adopt; but the characters of all the degrees and all the indications of species have been taken from nature, either in the Cabinet of Anatomy or in the galleries of the Museum.

The same plan was pursued with respect to the Birds. I have examined with the closest attention more than four thousand individuals in the Museum ; I arranged them according to my views in the public gallery more than five years ago, and all that is said of this class has been drawn from that source. Thus, any resemblance which my sub-divisions may bear to some recent descriptions, is on my part purely accidental.*

Naturalists, I hope, will approve of the numerous sub-genera which I have deemed it necessary to make among the birds of prey, the *Passerinæ*, and the Shore-birds ; they appear to me to have completely elucidated genera hitherto involved in much confusion. I have marked, as exactly as I could, the accordance of these subdivisions with the genera of MM. de Lacepède, Meyer, Wolf, Temminck, and Savigny, and have referred to each of them all the species of which I could obtain a very positive knowledge. This laborious work will prove of value to those who may hereafter attempt a true history of birds. The splendid works on Ornithology published within a few years, and those chiefly of M. le Vaillant, which are filled with so many interesting observations, together with M. Vieillot's, have been of much assistance to me in designating the species which they represent.

The general division of this class remains as I published it in 1798, in my *Tableau Élémentaire*.†

I have thought proper to preserve for the Reptiles, the general division of my friend M. Brongniart; but I have prosecuted very extensive anatomical investigations to arrive at the ulterior subdivisions. M. Oppel, as I have already stated, has partly taken advantage of these preparatory labours ; and whenever my genera finally agreed with his, I have noticed the fact. The work of Daudin, indifferent as it is, has been useful to me for indications of details ; but the particular divisions which I have given in the genera of Monitors and Geckos, are the product of my own observations on a great number of Reptiles recently brought to the Museum by MM. Péron and Geoffroy.

My labours on the Fishes will probably be found to exceed those which I have bestowed on the other vertebrated animals. Our Museum having received a vast number of Fishes since the celebrated work of M. de Lacepède was published, I have been enabled to add many subdivisions to those of that learned naturalist, also to combine several species differently, and to multiply anatomical observations. I have also had

* This observation not having been sufficiently understood abroad, I am obliged to repeat it here, and openly to declare a fact witnessed by thousands in Paris ; it is this, that all the birds in the gallery of the Museum were named and arranged according to my system, in 1811. Those even of my subdivisions to which I had not yet given names, were marked by particular signs. This is my date. Independently of this, my first volume was printed in the beginning of 1816. Four volumes are not printed so quickly as a pamphlet of a few pages. I say no more. (Note to Edit. 1829).

† I only mention this because an estimable naturalist, M. Vieillot, has, in a recent work, attributed to himself the union of the *Picæ* and *Passeres*. I had printed it in 1798, together with my other arrangements, so as to render them public in the Museum since 1811 and 1813

better means of verifying the species of Commerson, and of some of other travellers; and, upon this point, I am much indebted to a review of the drawings of Commerson, and of the dried fishes which he brought with him, by M. Dumeril, but which have only been very lately recovered;—resources to which I have added those presented to me in the fishes brought by Péron from the Indian Ocean and Archipelago, those which I obtained in the Mediterranean, and the collections made on the coast of Coromandel by the late M. Sonnerat, at the Mauritius by M. Matthieu, in the Nile and Red Sea, by M. Geoffroy, &c. I was thus enabled to verify most of the species of Bloch, Russell, and others, and to prepare the skeletons and viscera of nearly all the sub-genera; so that this part of the work will, I presume, offer much that is new to Icthyologists.

As to my division of this class, I confess its inconvenience, but I believe it, nevertheless, to be more natural than any preceding one. In publishing it some time ago, I only offered it for what it is worth; and if any one should discover a better principle of division, and as conformable to the organization, I shall hasten to adopt it.

It is admitted that all the works on the general division of the invertebrated animals, are mere modifications of what I proposed in 1795, in the first of my memoirs; and the time and care which I have devoted to the anatomy of mollusks in general, and principally to the naked mollusks, are well known. The determining of this class, as well as of its divisions and subdivisions, rests upon my own observations; the magnificent work of M. Poli had alone anticipated me by descriptions and anatomical researches useful for my design, but confined to bivalves and multivalves only. I have verified all the facts furnished by that able anatomist, and I believe that I have more justly marked the functions of some organs. I have also endeavoured to determine the animals to which belong the principal forms of shells, and to arrange the latter from that consideration; but with regard to the ulterior divisions of those shells of which the animals resemble each other, I have examined them only so far as to enable me to describe briefly those admitted by MM. de Lamarck and de Montfort; even the small number of genera and sub-genera which are properly mine, are principally derived from observations on the animals. In citing examples, I have confined myself to a certain number of the species of Martini, Chemnitz, Lister, and Soldani; and that only because, the volume in which M. Lamarck treats of this portion not having yet appeared, I was compelled to fix the attention of my readers on specific objects. But in the choice and determining of these species, I lay no claim to the same critical accuracy which I have employed for the vertebrated animals and naked mollusks.

The excellent observations of MM. Savigny, Lesueur, and Desmarest, on the compound Ascidians, approximate this latter family of mollusks to certain orders of zoophytes: this is a curious relation, and a further proof of the impracticability of arranging animals in a single line.

I believe that I have extricated the Annelides,—the establishing of which, although not their name, belongs virtually to me,—from the confusion in which they had hitherto been involved, among the Mollusks, the Testacea, and the Zoophytes, and have placed them in their natural order; even their genera have received some elucidation only by my observations, published in the *Dictionnaire des Sciences Naturelles*, and elsewhere.

Of the three classes contained in the third volume, I have nothing to remark.

M. Latreille, who, with the exception of some anatomical details, founded on my own observations and those of M. Ramdohr, which I have inserted in his text, is its sole author, will take upon himself to explain all that is necessary.

As to the Zoophytes, which terminate the Animal Kingdom, I have availed myself, for the Echinoderms, of the recent work of M. de Lamarck; and for the Intestinal Worms, of that of M. Rudolphi, intitled *Entozoa;* but I have anatomized all the genera, some of which have been determined by me only. There is an excellent work by M. Tiédemann, on the anatomy of the Echinoderms, which received the prize of the Institute some years ago, and will shortly appear; it will leave nothing to be desired respecting these curious animals. The Corals and the Infusoria, offering no field for anatomical investigations*, will be briefly disposed of. The new work of M. de Lamarck will supply my deficiencies.†

With respect to authors, I can only here mention those who have furnished me with general views, or who were the origin of such in my own mind.‡ There are many others to whom I am indebted for particular facts, and whose names I have carefully quoted wherever I have made use of them. They will be found on every page of my book. Should I have omitted to do justice to any, it must be attributed to involuntary forgetfulness, and I ask pardon beforehand: there is no property, in my opinion, more sacred than the conceptions of the mind; and the custom, too prevalent among naturalists, of masking plagiarisms by a change of names, has always appeared to me a crime.

The publication of my Comparative Anatomy will now occupy me every moment: the materials are ready; a vast quantity of preparations and drawings are arranged; and I shall be careful in dividing the work into parts, each of which will form a whole, so that, should my physical powers prove insufficient for the completion of my design, what I have produced will still form entire suites, and the materials I have collected be in immediate readiness for those who may undertake the continuation of my labours.

Jardin du Roi, October, 1816.

PREFACE TO THE SECOND EDITION.

THE preceding preface explains faithfully the condition in which I found the history of animals when the first edition of this work was published. During the twelve years that have since elapsed, this science has made immense progress, not only from the acquisitions of numerous travellers, as well-instructed as courageous, who have explored every region of the globe, but by the rich collections which various governments have formed and rendered public, and by the learned and

* The surprising researches of M. Ehrenberg, now publishing from time to time, triumphantly refute this allegation.—ED.

† I have just received *L'Histoire des Polypiers correlligenes flexibles* of M. Lamouroux, which furnishes an excellent supplement to M. de Lamarck.

‡ M. de Blainville has recently published general zoological tables, which I regret came too late for me to profit by, having appeared when my book was nearly printed.

splendid works, wherein new species are described and figured, and of which the authors have striven to detect their mutual relations, and to consider them in every point of view.*

I have endeavoured to avail myself of these discoveries, as far as my plan permitted, by first studying the innumerable specimens received at the Cabinet du Roi, and comparing them with those which served as the basis of my first edition, in order thence to deduce new approximations or subdivisions; and then, by searching in all the books I could procure for the genera or sub-genera established by naturalists, and the descriptions of species by which they have supported these numerous combinations.

The determination of synonymes has become much easier now than at the period of my first edition. Both French and foreign naturalists appear to have recognized the necessity of establishing divisions in the vast genera in which such incongruous species were formerly heaped together; their groups are now precise and well-defined; their descriptions sufficiently detailed; their figures scrupulously exact to the most minute characters, and often of the greatest beauty as works of art. Scarcely any difficulty remains, therefore, in identifying their species, and nothing hinders them from coming to an understanding with respect to the nomenclature. This, unfortunately, has been the most neglected; the names of the same genera, and the same species, are multiplied as often as they are mentioned; and should this discord continue, the same chaos will be produced that previously existed, though arising from another cause.

I have used every effort to compare and approximate these redundancies, and, forgetting even my own trifling interest as an author, have often indicated names which seemed to have been imagined only to escape the avowal of having borrowed my divisions. But thoroughly to execute this undertaking,—this *pinax* or rectified epitome of the animal kingdom, which becomes every day more necessary,—to discuss the proofs and fix the definitive nomenclature which should be adopted, by basing it on sufficient figures and descriptions, requires more space than I could dispose of, and a time imperatively claimed by other works. In the History of Fishes, which I have commenced publishing, with the assistance of M. Valenciennes, I purpose to give an idea of what appears to me might be effected in all parts of the science. Here, I only profess to offer an abridged summary—a simple sketch;—well satisfied if I succeed in rendering this accurate in all its details.

Various essays of a similar kind have been published on some of the classes, and I have carefully studied them with a view to perfect my own. The *Mammalogie* of M. Desmarest, that of M. Lesson, the Treatise on the Teeth of Quadrupeds, by M. Frederic Cuvier, the English translation of my first edition, by Mr. Griffith, enriched by numerous additions, particularly by Hamilton Smith; the new edition of the *Manuel d'Ornithologie* of M. Temminck, the Ornithological Fragments of M. Wagler, the History of Reptiles of the late Merrem, and the Dissertation on the same subject by M. Fitsinger, have principally been useful to me for the vertebrated animals. The *Histoire des Animaux sans Vertèbres* of M. de Lamarck, the *Malacologie* of M. de Blainville, have also been of great service to me for the mollusks. To

* See my discourse before the Institute on the *Progres de l'histoire naturelle depuis la paix maritime* published at the close of the first volume of my Eloges.

these I have added the new views and facts contained in the numerous and learned writings of MM. Geoffroy St. Hilaire, father and son, Savigny, Temminck, Lichtenstein, Kuhl, Wilson, Horsfield, Vigors, Swainson, Gray, Ord, Say, Harlan, Charles Bonaparte, Lamouroux, Mitchell, Lesueur, and many other able and studious men, whose names will be carefully mentioned when I speak of the subjects on which they have treated.

The fine collections of engravings which have appeared within the last twelve years, have enabled me to indicate a greater number of species; and I have amply profited by this facility. I must particularly acknowledge what I owe on this score to the *Histoire des Mammifères* of MM. Geoffroy St. Hilaire and Frederic Cuvier, the *Planches coloriées* of MM. Temminck and Laugier, the *Galerie des Oiseaux* of M. Vieillot, the new edition of the Birds of Germany, by MM. Nauman, the Birds of the United States of Messrs. Wilson, Ord, and Charles Bonaparte*, the great works of M. Spix, and of his Highness the Prince Maximilian de Wied, on the Animals of Brazil, and to those of M. de Ferussac on the Mollusks. The plates and zoological descriptions of the travels of MM. Freycinet and Duperrey, supplied in the first by MM. Quoy and Gaymard, in the second by MM. Lesson and Garnot, also present many new objects. The same must be said of the Animals of Java, by Dr. Horsfield. Though on a smaller scale, new figures of rare species are to be found in the *Mémoires du Muséum*, the *Annales des Sciences Naturelles*, and other French periodicals, in the Zoological Illustrations of Mr. Swainson, and in the Zoological Journal, published by able naturalists in London. The Journal of the Lyceum of New York, and of the Academy of Natural Sciences of Philadelphia, are not less valuable; but in proportion as the taste for natural history becomes extended, and the more numerous the countries in which it is cultivated, the number of its acquisitions increases in geometrical progression, and it becomes more and more difficult to collect all the writings of naturalists, and to complete the table of their results. I rely, therefore, on the indulgence of those whose observations may have escaped me, or whose works I have not sufficiently consulted.

My celebrated friend and colleague M. Latreille, having consented, as in the first edition, to take upon himself the important and difficult part of the Crustaceans, Arachnides, and Insects, will himself explain in an advertisement the plan he has followed, so that I need say nothing more on this subject.

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Jardin du Roi, October, 1828.

* The work of M. Audubon upon the Birds of North America, which surpasses all others in magnificence, was unknown to me till after the whole of that part which treats of Birds was printed.

INTRODUCTION

AND

GENERAL PLAN OF THE WORK.

OF NATURAL HISTORY, AND OF SYSTEMS GENERALLY.

As few persons have a just idea of *Natural History*, it appears necessary to commence our work by carefully defining the proposed object of this science, and establishing rigorous limits between it and the contiguous sciences.

The word NATURE, in our language, and in most others, signifies—sometimes, the qualities which a being derives from birth, in opposition to those which it may owe to art; at other times, the aggregate of beings which compose the universe; and sometimes, again, the laws which govern these beings. It is particularly in this latter sense that it has become customary to personify Nature, and to employ the name, respectfully, for that of its Author.

Physics, or *Natural Philosophy*, treats of the nature of these three relations, and is either general or particular. *General Physics* examines, abstractedly, each of the properties of those moveable and extended beings which we call bodies. That department of them styled *Dynamics*, considers bodies in mass; and, proceeding from a very small number of experiments, determines mathematically the laws of equilibrium, and those of motion and of its communication. It comprehends in its different divisions the names of *Statics, Mechanics, Hydrostatics, Hydrodynamics, Pneumatics*, &c., according to the nature of the bodies of which it examines the motions. *Optics* considers the particular motions of light; the phenomena of which, requiring experiments for their determination, are becoming more numerous.

Chemistry, another branch of General Physics, expounds the laws by which the elementary molecules of bodies act on each other when in close proximity, the combinations or separations which result from the general tendency of these molecules to unite, and the modifications which different circumstances, capable of separating or approximating them, produce on that tendency. It is a science almost wholly experimental, and which cannot be reduced to calculation.

The theory of Heat, and that of Electricity, belong almost equally to Dynamics or Chemistry, according to the point of view in which they are considered.

The method which prevails in all the branches of General Physics consists in isolating bodies, reducing them to their utmost simplicity, in bringing each of their properties separately into action, either mentally or by experiment, in observing or calculating the results, in short, in generalizing and correcting the laws of these pro-

perties for the purpose of establishing a body of doctrine, and, if possible, of referring the whole to one single law, under the universal expression of which all might be resolved.

Particular Physics, or *Natural History*,—for these terms are synonymous—has for its object to apply specially the laws recognized by the various branches of General Physics, to the numerous and varied beings which exist in nature, in order to explain the phenomena which they severally present.

In this extended sense, it would also include Astronomy; but that science, sufficiently elucidated by Mechanics, and completely subjected to its laws, employs methods too different from those required by ordinary Natural History, to permit of its cultivation by the students of the latter.

Natural History, then, is confined to objects which do not allow of rigorous calculation, or of precise measurement in all their parts. *Meteorology*, also, is subtracted from it, to be ranged under General Physics; so that, properly speaking, it considers only inanimate bodies, called minerals, and the various kinds of living beings, in all which we may observe the effects, more or less various, of the laws of motion and chemical attraction, and of all the other causes analyzed by General Physics.

Natural History should, in strictness, employ the same modes of procedure as the general sciences; and it does so, in fact, whenever the objects of its study are so little complex as to permit of it. But this is very seldom the case.

An essential difference, in effect, between the general sciences and Natural History is, that, in the former, phenomena are examined, the conditions of which are all regulated by the examiner, in order, by their analysis, to arrive at general laws; while in the latter, they occur under circumstances beyond the control of him who studies them for the purpose of discovering, amid the complication, the effects of general laws already known. It is not permitted for him, as in the case of the experimenter, to subtract successively from each condition, and so reduce the problem to its elements; but he must take it entire, with all its conditions at once, and can analyze only in thought. Suppose, for example, we attempt to isolate the numerous phenomena which compose the life of an animal a little elevated in the scale; a single one being suppressed, the life is wholly annihilated.

Dynamics have thus become a science almost purely of calculation; Chemistry is still a science wholly [chiefly*] of experiment; and Natural History will long remain, in a great number of its branches, one of pure observation.

These three terms sufficiently designate the modes of procedure employed in the three branches of the Natural Sciences; but in establishing between them very different degrees of certitude, they at the same time indicate the point to which the two latter should tend, in order to approach perfection.

Calculation, so to speak, commands Nature; it determines phenomena more exactly than observation can make them known: experiment forces her to unveil; while observation watches her when deviating from her normal course, and seeks to surprise her.

Natural History has, moreover, a principle on which to reason, which is peculiar to it, and which it employs advantageously on many occasions; it is that of the *conditions of existence*, commonly termed *final causes*. As nothing can exist without the concurrence of those conditions which render its existence possible, the component parts of each

* The discovery of the atomic theory has reduced many of its phenomena to calculation.—E.

must be so arranged as to render possible the whole living being, not only with regard to itself, but to its surrounding relations; and the analysis of these conditions frequently conducts to general laws, as demonstrable as those which are derived from calculation or experiment.

It is only when all the laws of general physics, and those which result from the conditions of existence, are exhausted, that we are reduced to the simple laws of observation.

The most effectual mode of observing is by comparison. This consists in successively studying the same bodies in the different positions in which Nature places them, or in a comparison of different bodies together, until constant relations are recognized between their structures and the phenomena which they manifest. These various bodies are kinds of experiments ready prepared by Nature, who adds to or subtracts from each of them different parts, just as we might wish to do in our laboratories, and shows us herself the results of such additions or retrenchments.

It is thus that we succeed in establishing certain laws, which govern these relations, and which are employed like those that have been determined by the general sciences.

The incorporation of these laws of observation with the general laws, either directly or by the principle of the conditions of existence, would complete the system of the natural sciences, in rendering sensible in all its parts the mutual influence of every being. This it is to which the efforts of those who cultivate these sciences should tend.

All researches of this kind, however, presuppose means of distinguishing with certainty, and causing others to distinguish, the objects investigated; otherwise we should be incessantly liable to confound the innumerable beings which Nature presents. Natural History, then, should be based on what is called a *System of Nature*, or a great catalogue, in which all beings bear acknowledged names, may be recognized by distinctive characters, and distributed in divisions and subdivisions themselves named and characterized, in which they may be found.

In order that each being may always be recognized in this catalogue, it should carry its character along with it: for which reason the characters should not be taken from properties, or from habits the exercise of which is transient, but should be drawn from the conformation.

There is scarcely any being which has a simple character, or can be recognized by an isolated feature of its conformation: the combination of many such traits is almost always necessary to distinguish a being from the neighbouring ones, which have some but not all of them, or have them combined with others of which the first is destitute; and the more numerous the beings to be discriminated, the more must these traits accumulate: insomuch that, to distinguish from all others an individual being, a complete description of it must enter into its character.

It is to avoid this inconvenience that divisions and subdivisions have been invented. A certain number of neighbouring beings only are compared together, and their particular characters need only to express their differences, which, by the supposition itself, are the less important parts of their conformation. Such a reunion is termed a *genus*.

The same inconvenience would recur in distinguishing genera from each other, were it not that the operation is repeated in collecting the neighbouring genera, so as to form an *order*; the neighbouring orders to form a *class*, &c. Intermediate subdivisions may also be established.

This scaffolding of divisions, the superior of which contain the inferior, is what is

called a *method*. It is, in some respects, a sort of dictionary, in which we proceed from the properties of things to discover their names; being the reverse of ordinary dictionaries, in which we proceed from the names to obtain a knowledge of the properties.

When the method, however, is good, it does more than teach us names. If the subdivisions have not been established arbitrarily, but are based on the true fundamental relations,—on the essential resemblances of beings, the method is the surest means of reducing the properties of these beings to general rules, of expressing them in the fewest words, and of stamping them on the memory.

To render it such, an assiduous comparison of beings is employed, directed by the principle of the *subordination of characters*, which is itself derived from that of the conditions of existence. All the parts of a being having a mutual correlativeness, some traits of conformation exclude others; while some, on the contrary, necessitate others: when, therefore, we perceive such or such traits in a being, we can calculate beforehand those which co-exist in it, or those that are incompatible with them. The parts, properties, or the traits of conformation, which have the greatest number of these relations of incompatibility or of co-existence with others, or, in other words, that exercise the most marked influence upon the whole of the being, are what are called *important characters*, *dominant characters;* the others are the *subordinate characters*, all varying, however, in degree.

This influence of characters is sometimes determined rationally, by considering the nature of the organ: when this is impracticable, recourse must be had to simple observation; and a sure means of recognizing the important characters, which is derived from their own nature, is, that they are more constant; and that in a long series of different beings, approximated according to their degrees of similitude, these characters are the last to vary.

From their influence and from their constancy result equally the rule, which should be preferred for distinguishing grand divisions, and in proportion as we descend to the inferior subdivisions, we can also descend to subordinate and variable characters.

There can only be one perfect method, which is the *natural method*. An arrangement is thus named in which beings of the same genus are placed nearer to each other than to those of all other genera; the genera of the same order nearer than to those of other orders, and so in succession. This method is the ideal to which Natural History should tend; for it is evident that, if we can attain it, we shall have the exact and complete expression of all nature. In fact, each being is determined by its resemblance to others, and its differences from them; and all these relations would be fully given by the arrangement which we have indicated. In a word, the natural method would be the whole science, and each step towards it tends to advance the science to perfection.

Life being the most important of all the properties of beings, and the highest of all characters, it is not surprising that it has been made in all ages the most general principle of distinction; and that natural beings have always been separated into two immense divisions, the *living* and the *inanimate*.

OF LIVING BEINGS, AND OF ORGANIZATION IN GENERAL.

If, in order to obtain a just idea of the essence of life, we consider it in those beings in which its effects are the most simple, we readily perceive that it consists in the

faculty which certain corporeal combinations have, of enduring for a time, and under a determinate form, by incessantly attracting into their composition a part of surrounding substances, and rendering to the elements portions of their own proper substance.

Life, then, is a vortex (*tourbillon*), more or less rapid, more or less complicated, the direction of which is constant, and which always carries along molecules of the same kind, but into which individual molecules are continually entering, and from which they are constantly departing ; so that the *form* of a living body is more essential to it than its *matter*.

As long as this movement subsists, the body in which it takes place is *living—it lives*. When it is permanently arrested, the body *dies*. After death, the elements which compose it, abandoned to the ordinary chemical affinities, are not slow to separate, from which, more or less quickly, results the dissolution of the body that had been living. It was then by the vital motion that its dissolution was arrested, and that the elements of the body were temporarily combined.

All living bodies die after a time, the extreme limit of which is determined for each species ; and death appears to be a necessary consequence of life, which, by its own action, insensibly alters the structure of the body wherein its functions are exercised, so as to render its continuance impossible.

In fact, the living body undergoes gradual but constant changes during the whole term of its existence. It increases first in dimensions, according to the proportions and within the limits fixed for each species, and for each of its several parts ; then it augments in density, in most of its parts :—it is this second kind of change that appears to be the cause of natural death.

On examining the various living bodies more closely, a common structure is discerned, which a little reflection soon causes us to adjudge as essential to a vortex, such as the vital motion.

Solids, it is evident, are necessary to these bodies for the maintenance of their forms, and fluids for the conservation of motion in them. Their tissue, then, is composed of interlacement and network, or of fibres and solid laminæ, which inclose the liquids in their interstices : it is in these liquids that the motion is most continual and most extended ; the extraneous substances penetrate the intimate tissue of bodies in incorporating with them ; they nourish the solids by interposing their molecules, and also detach from them their superfluous molecules : it is in a liquid or gaseous form that the matters to be exhaled traverse the pores of the living body ; but, in return, it is the solids which contain these fluids, and by their contraction communicate to them a part of their motion.

This mutual action of the solids and fluids, this passage of molecules from one to the other, necessitated considerable affinity in their chemical composition ; and, accordingly, the solids of organized bodies are in great part composed of elements easily convertible into liquids or gases.

The motion of the fluids, requiring also a continually repeated action on the part of the solids, and communicating one to them, demanded of the latter both flexibility and dilatability ; and hence we find this character nearly general in all organized solids.

This fundamental structure, common to all living bodies—this areolar tissue, the more

or less flexible fibres or laminæ of which intercept fluids more or less abundant—constitutes what is termed the *organization;* and, as a consequence of what we have said, it follows that only organized bodies can enjoy life.

Organization, then, results from a great number of dispositions or arrangements, which are all conditions of life; and it is easy to conceive that the general movement of the life would be arrested, if its effect be to alter either of these conditions, so as to arrest even one of the partial motions of which it is composed.

Every organized body, besides the qualities common to its tissue, has one proper form, not only in general and externally, but also in the detail of the structure of each of its parts; and it is upon this form, which determines the particular direction of each of the partial movements that take place in it, that depends the complication of the general movement of its life, which constitutes its species, and renders it what it is. Each part concurs in this general movement by a peculiar action, and experiences from it particular effects; so that, in every being, the life is a whole, resulting from the mutual action and reaction of all its parts.

Life, then, in general, presupposes organization in general, and the life proper to each being presupposes the organization peculiar to that being, just as the movement of a clock presupposes the clock; and, accordingly, we behold life only in beings that are organized and formed to enjoy it; and all the efforts of philosophers have not yet been able to discover matter in the act of organization, either of itself or by any extrinsic cause. In fact, life exercising upon the elements which at every instant form part of the living body, and upon those which it attracts to it, an action contrary to that which would be produced without it by the usual chemical affinities, it is inconsistent to suppose that it can itself be produced by these affinities, and yet we know of no other power in nature capable of reuniting previously separated molecules.

The birth of organized beings is, therefore, the greatest mystery of the organic economy and of all nature: we see them developed, but never being formed; nay, more, all those of which we can trace the origin, have at first been attached to a body of the same form as their own, but which was developed before them;—in one word, to a *parent*. So long as the offspring has no independent life, but participates in that of its parent, it is called a *germ*.

The place to which the germ is attached, and the occasional cause which detaches it, and gives it an independent life, vary; but the primitive adherence to a similar being is a rule without exception. The separation of the germ is what is designated *generation*.

All organized beings produce similar ones; otherwise, death being a necessary consequence of life, their species would not endure.

Organized beings have even the faculty of reproducing, in degrees varying with the species, certain of their parts of which they may have been deprived. This has been named the power of *reproduction*.

The developement of organized beings is more or less rapid, and more or less extended, according as circumstances are differently favourable. Heat, the supply and quality of nourishment, with other causes, exert great influence; and this influence may extend to the whole body in general, or to certain organs in particular:—hence the similitude of offspring to their parents can never be complete.

Differences of this kind, between organized beings, are what are termed *varieties*.

There is no proof that all the differences which now distinguish organized beings are such as may have been produced by circumstances. All that has been advanced upon this subject is hypothetical: experience seems to show, on the contrary, that, in the actual state of things, varieties are confined within rather narrow limits; and, so far as we can retrace antiquity, we perceive that these limits were the same as at present.

We are then obliged to admit of certain forms, which, since the origin of things, have been perpetuated without exceeding these limits; and all the beings appertaining to one of these forms constitute what is termed a *species*. Varieties are accidental subdivisions of species.

Generation being the only means of ascertaining the limits to which varieties may extend, species should be defined *the reunion of individuals descended one from the other, or from common parents, or from such as resemble them as closely as they resemble each other*; but, although this definition is rigorous, it will be seen that its application to particular individuals may be very difficult when the necessary experiments have not been made.*

To recapitulate,—absorption, assimilation, exhalation, developement, and generation, are the functions common to all living beings; birth and death, the universal limits of their existence; a porous, contractile tissue, containing within its laminæ liquids or gases in motion, the general essence of their structure; substances almost all susceptible of being converted into liquids or gases, and combinations capable of easy transformation into one another, the basis of their chemical composition. Fixed forms, and which are perpetuated by generation, distinguish their species, determine the complication of the secondary functions proper to each of them, and assign to them the office they have to fulfil in the grand scheme of the universe. These forms neither produce nor change themselves; the life supposes their existence; it can exist only in organizations already prepared; and the most profound meditations, assisted by the most delicate observations, can penetrate no further than the mystery of the pre-existence of germs.

DIVISION OF ORGANIZED BEINGS INTO ANIMALS AND VEGETABLES.

Living or organized beings have been subdivided, from the earliest times, into *animate beings*, or those possessing sense and motion, and *inanimate beings*, which enjoy

* That insurmountable difficulties oppose the rigid determination of species, and, consequently, render even the definition of the term impossible, except in a very vague and loose manner, will readily appear on consideration of some of the phenomena presented. The prevalent idea is, that a *species* consists of the aggregate of individuals descended from one original parentage, which alone are supposed to be capable of producing offspring that are prolific *inter se*; and that when individuals, not of the same pristine derivation, interbreed, the hybrids are necessarily *mules*, which are either quite sterile, or at most can only propagate with individuals of unmixed descent. But it so happens, that every possible grade of approximation is manifested, from the most diverse races, to those which are utterly undistinguishable; while, even in the latter case, urgent analogies, notwithstanding, sometimes forcibly indicate a separateness of origin; as when a series of analogous races inhabiting distant regions are compared together, some of which are obviously different, others doubtfully so, and some apparently identical. And it remains to be shown whether such intimately allied races as some of these, even if not descended from a common stock, (which of course cannot be ascertained), would not produce hybrids capable of transmitting and perpetuating the mingled breed. It is true that Cuvier guards against this contingency, in the wording of his definition; and that most naturalists would concur in regarding such miscible races, however dissimilar, as *varieties* merely of the same; but a question arises, whether there be not *different degrees* of fertility in hybrids, corresponding to the amount of *affinity*, or physiological accordancy, subsisting betwixt the parent races; it being only within a certain sphere of that affinity that they can be produced at all: besides which, as hybrids are seldom exactly intermediate, and in some instances (particularly among multiparous races) have been known to resemble entirely one or the other parent, it may be presumed that this circumstance would also materially affect their capability of propagation. Experiments are needed to solve this important problem, though there is every reason to suspect that the following proposition will eventually gain the general assent of naturalists, viz., that *while considerable dissimilarity does not of necessity imply specifical diversity, the converse equally holds, that absolute resemblance fails of itself to constitute specifical identity.*—Ed.

neither the one nor the other of these faculties, but are reduced to the simple function of vegetating. Although many plants retract their leaves when touched, and the roots direct themselves constantly towards moisture, the leaves towards air and light, and though some parts of vegetables appear even to exhibit oscillations without any perceptible external cause, still these various movements bear too little resemblance to those of animals to enable us to recognize in them any proofs of perception or of will.

The spontaneity of the movements of animals required essential modifications, even in their simply vegetative organs. Their roots not penetrating the ground, it was necessary that they should be able to place within themselves provisions of food, and to carry its reservoir along with them. Hence is derived the first character of animals, or their alimentary cavity, from which their nutritive fluid penetrates all other parts through pores or vessels, which are a sort of internal roots.

The organization of this cavity and of its appurtenances required varying, according to the nature of the aliment, and the operations which it had to undergo before it could furnish juices proper for absorption : whilst the atmosphere and the earth supply to vegetables only juices ready prepared, and which can be absorbed immediately.

The animal body, which abounds with functions more numerous and more varied than in the plant, required in consequence to have an organization much more complicated; besides which, its parts not being capable of preserving a fixed relative position, there were no means by which the motion of their fluids could be produced by external causes, as it required to be independent of heat and of the atmosphere : from this originates the second character of animals, or their circulatory system, which is less essential than the digestive, since it was unnecessary in the more simple animals.

The animal functions required organic systems, not needed by vegetables, as that of the muscles for voluntary motion, and that of the nerves for sensibility; and these two systems, like the rest, acting only through the motions and transformations of the fluids, it was necessary that these should be more numerous in animals, and that the chemical composition of the animal body should be more complicated than that of the plant: and so it is, for an additional substance (azote) enters into it as an essential element, while in plants it is a mere accidental junction with the three other general elements of organization,— oxygen, hydrogen, and carbon. This then is the third character of animals.

The soil and the atmosphere supply to vegetables water for their nutrition, which is composed of oxygen and hydrogen, air, which contains oxygen and azote, and carbonic acid, which is a combination of oxygen and carbon. To extract from these aliments their proper composition, it was necesary that they should retain the hydrogen and carbon, exhale the superfluous oxygen, and absorb little or no azote. Such, then, is the process of vegetable life, of which the essential function is the exhalation of oxygen, which is effected through the agency of light.

Animals in addition derive nourishment, more or less immediately, from the vegetable itself, of which hydrogen and carbon form the principal constituents. To assimilate them to their own composition, they must get rid of the superfluous hydrogen, and especially of the superabundant carbon, and accumulate more azote; this it is which is performed in respiration, by means of the oxygen of the atmosphere combining with the hydrogen and carbon of the blood, and being exhaled with them under the form of

water and carbonic acid. The azote, whatever part of their body it may penetrate, appears to remain there.

The relations of vegetables and animals with the atmosphere are then inverse; the former retain (*défont*) water and [decompose] carbonic acid, while the latter reproduce them. Respiration is the function essential to the constitution of an animal body; it is that which in a manner animalizes it; and we shall see that animals exercise their peculiar functions more completely, according as they enjoy greater powers of respiration. It is in this difference of relations that the fourth character of animals consists.

OF THE FORMS PECULIAR TO THE ORGANIC ELEMENTS OF THE ANIMAL BODY, AND OF THE PRINCIPAL COMBINATIONS OF ITS CHEMICAL ELEMENTS.

An areolar tissue and three chemical elements are essential to every living body, a fourth element being peculiar to that of animals; but this tissue is composed of variously formed meshes, and these elements are united in different combinations.

There are three kinds of organic materials, or forms of tissue,—the *cellular membrane*, the *muscular fibre*, and the *medullary matter;* and to each form belongs a peculiar combination of chemical elements, together with a particular function.

The *cellular membrane* is composed of an infinity of small laminæ, fortuitously disposed, so as to form little cells that communicate with each other. It is a sort of sponge, which has the same form as the entire body, all other parts of which fill or traverse it. Its property is to contract indefinitely when the causes which sustain its extension cease to operate. It is this force that retains the body in a given form, and within determined limits.

When condensed, this substance forms those more or less extended laminæ which are called *membranes;* the membranes, rolled into cylinders, compose those tubes, more or less ramified, which are termed *vessels;* the filaments, named *fibres*, resolve themselves into it; and the *bones* are nothing but the same, indurated by the accumulation of earthy particles.

The cellular substance consists of that combination [isinglass] which bears the name of *gelatine*, and the character of which is to dissolve in boiling water, and to assume the form, when cold, of a trembling jelly.

The *medullary matter* has not yet been reduced to its organic molecules: it appears to the naked eye as a sort of soft *bouillie* [pultaceous mass], consisting of excessively small globules; it is not susceptible of any apparent motion, but in it resides the admirable power of transmitting to the ME the impressions of the external senses, and of conveying to the muscles the mandates of the will. The brain and the spinal chord are chiefly composed of it; and the nerves, which are distributed to all the sentient organs, are, essentially, but ramifications of the same.

The *fleshy* or *muscular fibre* is a peculiar sort of filament, the distinctive property of which, during life, is that of contracting when touched or struck, or when it experiences, through the medium of the nerves, the action of the will.

The muscles, immediate organs of voluntary motion, are merely bundles of fleshy fibres. All the membranes, all the vessels which need to exercise any compression, are furnished with these fibres. They are always intimately connected with nervous threads; but those which subserve the purely vegetative functions contract without

the knowledge of the ME, so that the will is indeed one means of causing the fibres to act, but which is neither general nor exclusive.

The fleshy fibre has for its base a particular substance termed *fibrine*, which is insoluble in boiling water, and of which the nature appears to be to take of itself this filamentous form.

The *nutritive fluid*, or the *blood*, such as we find in the vessels of the circulation, not only resolves itself principally into the general elements of the animal body,—carbon, hydrogen, oxygen, and azote, but it also contains fibrine and gelatine, all but disposed to contract, and to assume the forms of membranes or of filaments peculiar to them, nought being ever acquired for their manifestation but a little repose. The blood presents also another combination, which occurs in many animal solids and fluids, namely, *albumen* [or *white of egg*], the characteristic property of which is to coagulate in boiling water. Besides these, the blood contains almost all the elements which may enter into the composition of the body of each animal, such as the lime and phosphorus, which hardens the bones of vertebrated animals, the iron, which colours the blood itself as well as various other parts, the fat or animal oil, which is deposited in the cellular substance to maintain it, &c. All the fluids and solids of the animal body are composed of chemical elements contained in the blood; and it is only by possessing some elements more or less, or in different proportions, that each is severally distinguished; whence it becomes apparent that their formation entirely depends on the subtraction of the whole or part of one or more elements of the blood, and, in some few cases, on the addition of some element from elsewhere.

The various operations, by which the blood supplies nourishment to the solid or liquid matter of all parts of the body, may take the general name of *secretion*. This term, however, is often exclusively appropriated to the production of liquids, while that of *nutrition* is applied more especially to the production and deposition of the matter necessary to the growth and conservation of the solids.

Every solid organ, as well as fluid, has the composition most appropriate for the office which it has to perform, and it preserves it so long as health continues, because the blood renews it as fast as it becomes changed. The blood itself, by this continual contribution, is altered every moment; but is restored by digestion, which renews its matter; by respiration, which sets free the superfluous carbon and hydrogen; and by perspiration and various other excretions, that relieve it from other superabundant principles.

These perpetual changes of chemical composition constitute part of the vital vortex, not less essential than the visible movements and those of translation: the object, indeed, of these latter is simply to produce the former.

OF THE FORCES WHICH ACT IN THE ANIMAL BODY.

The muscular fibre is not only the organ of voluntary motion; we have seen that it is also the most powerful of the means employed by nature to effect the movements of translation necessary to vegetative life. Thus the fibres of the intestines produce the peristaltic motion, which causes the aliment to pass onward along this canal; the fibres of the heart and arteries are the agents of the circulation, and, through it, of all the secretions, &c.

The will causes the fibre to contract through the medium of the nerve; and the involuntary fibres, such as those we have mentioned, are equally animated by the nerves which pervade them; it is, therefore, probable, that these nerves are the cause of their contraction.

All contraction, and, generally speaking, all change of dimension in nature, is produced by a change of chemical composition, though it consists merely in the flowing or ebbing of an imponderable *, such as caloric; it is thus also that the most violent of known movements are occasioned, as combustions, detonations, &c.

There is, then, great reason for supposing that it is by an imponderable fluid that the nerve acts upon the fibre; and the more especially, as it is demonstrated that this action is not mechanical.

The medullary matter of the whole nervous system is homogeneous, and must exercise, wherever it is found, the functions appertaining to its nature; all its ramifications receive a great abundance of blood-vessels.

All the animal fluids being derived from the blood by secretion, it cannot be doubted that the same holds with the nervous fluid, nor that the medullary matter secretes [or evolves] it.

On the other hand, it is certain that the medullary matter is the sole conductor of the nervous fluid; and that all the other organic elements serve as non-conductors, and arrest it, as glass arrests electricity.

The external causes which are capable of producing sensations, or of occasioning contractions in the fibre, are all chemical agents, capable of effecting decompositions, such as light, caloric, the salts, odorous vapours, percussion, compression, &c.

It would seem, then, that these causes act upon the nervous fluid chemically, and by changing its composition: which appears the more likely, as their action becomes weakened by continuance, as if the nervous fluid needed to resume its primitive composition in order to be altered anew.

The external organs of sense may be compared to sieves, which allow nothing to pass through to the nerve except the species of agent which should affect it in that particular place, but which often accumulates so as to increase the effect. The tongue has its spongy papillæ, which imbibe saline solutions: the ear a gelatinous pulp, which is intensely agitated by sonorous vibrations; the eye transparent lenses which concentrate the rays of light, &c.

It is probable that what are styled irritants, or the agents which occasion the contractions of the fibre, exert this action by producing on the fibre, by the nerve, the same effect which is produced by the will; that is to say, by altering the nervous fluid in the manner necessary to change the dimensions of the fibre on which it has influence; but the will has nothing to do in this action; the ME is often even without any knowledge of it. The muscles separated from the body are still susceptible of irritation, so long as the portion of the nerve distributed within them preserves its power of acting on them; the will being evidently unconnected with this phenomenon.

The nervous fluid is altered by muscular irritation, as well as by sensation and voluntary motion; and the same necessity occurs for the re-establishment of its primitive composition.

The movements of translation necessary to vegetative life are determined by irritants:

* "Imponderable fluid" is the expression in the original.—ED.

the aliment irritates [or excites] the intestine, the blood irritates the heart, &c. These movements are all independent of the will, and in general (while health endures) take place without the cognizance of the ME; the nerves which produce them have even, in several parts, a different distribution from that of the nerves affected by sensations or subject to the will, and the object of the difference appears to be the securing of this independence.*

The nervous functions, that is to say, sensitiveness and muscular irritability, are so much the stronger at every point, in proportion as the exciting cause is more abundant; and as this agent, or the nervous fluid, is produced by secretion [or evolution], its abundance must be in proportion to the quantity of medullary or secretory matter, and the amount of blood received by the latter.

In animals that have a circulation, the blood is propelled through the arteries which convey it to its destined parts, by means of their irritability and that of the heart. If these arteries be irritated, they act more vigorously, and propel a greater quantity of blood; the nervous fluid becomes more abundant, and augments the local sensibility; this, in its turn, increases the irritability of the arteries, so that this mutual action may be carried to a great extent. It is termed *orgasm*, and when it becomes painful and permanent, *inflammation*. The irritation may also originate in the nerve, when it experiences acute sensations.

This mutual influence of the nerves and fibres, either in the intestinal system, or in the arterial system, is the real spring of vegetative life in animals.

As each external sense is permeable only by particular kinds of sensation, so each internal organ may be accessible only to such or such agent of irritation. Thus, mercury irritates the salivary glands, cantharides excite the bladder, &c. These agents are what are termed *specifics*.

The nervous system being homogeneous and continuous, local sensations and irritation debilitate the whole: and each function, carried too far, may enfeeble the others. Excess of aliment thus weakens the faculty of thought; while prolonged meditation impairs the energy of digestion, &c.

Excessive local irritation will enfeeble the whole body, as if all the powers of life were concentrated on a single point.

A second irritation produced at another point may diminish, or *divert* as it is termed, the first; such is the effect of purgatives, blisters, &c. [denominated counter-irritation].

All rapid as the foregoing enunciation is, it is sufficient to establish the possibility of accounting for all the phenomena of physical life, by the simple admission of a fluid such as we have defined, from the properties which it manifests.†

* In the above sentence, there are distinctly mentioned the three sorts of nerves, the separate functions of which have been conclusively demonstrated by Sir Charles Bell: viz., nerves of *volition*, which transmit the mandates of the will; of *sensation*, which convey to the sensorium the impressions of the senses; and of *sympathy*, or involuntary movement, the reunion of the ramifications of which in a plexus of knots, or ganglions, is intimated in the text, those of the second class being distinguished by a swelling or ganglion near their base.—ED.

† The unceasing chemical changes consequent upon vitality must necessarily develope electricity; and that the *nervous fluid* is no other than the *electric*, may be considered as proved by the identity of their phenomena. Indeed, it has long been known that the transmission of voltaic electricity along the nerves of a recently dead animal, suffices to produce the most violent muscular action; but the regulation of that action, its exclusive direction to particular suites of muscles, requires the vital impulse. "If the brain," remarks Sir John Herschel, "(for which wonderfully constituted organ no other mode of action possessing the least probability has ever been devised), be an electric pile, constantly in action, it may be conceived to discharge itself at regular intervals, when the tension of the electricity developed reaches a certain point, along the nerves which communicate with the heart, and thus to excite the pulsations of that organ. This idea is forcibly suggested by a view of that elegant apparatus, the dry pile of Deluc, in which the successive accumulations of electricity are carried off by a suspended ball, which is kept, by the discharges, in a state of regular pulsation for any length of time. We have witnessed the action of such a pile, maintained in this way for whole years, in the study of the above-named eminent philosopher. The same idea of the cause of the pulsation of the heart appears to have occurred to Dr. Arnott, and is mentioned in his useful and excellent work on Physics, to which, however, we are not indebted for the suggestion, it having occurred to us independently many years ago."—*Discourse on the Study of Natural Philosophy*, p. 343.—ED.

SUMMARY IDEA OF THE FUNCTIONS AND ORGANS OF THE BODIES OF ANIMALS, AND OF THEIR VARIOUS DEGREES OF COMPLICATION.

After what we have stated respecting the organic elements of the body, its chemical principles, and the forces which act within it, it remains only to give a summary idea in detail of the functions of which life is composed, and of their respective organs.

The functions of the animal body are divided into two classes:—

The animal functions, or those proper to animals,— that is to say, sensibility and voluntary motion.

The vital, vegetative functions, or those common to animals and vegetables; that is to say, nutrition and generation.

Sensibility resides in the nervous system.

The most general external sense is that of touch; its seat is in the skin, a membrane enveloping the whole body, and traversed all over by nerves, of which the extreme filaments expand on the surface into papillæ, and are protected by the epidermis, and by other insensible teguments, such as hairs, scales, &c. Taste and smell are merely delicate states of the sense of touch, for which the skin of the tongue and nostrils is particularly organized; the former by means of papillæ more convex and spongy; the latter, by its extreme delicacy and the multiplication of its ever humid surface. We have already spoken of the eye and ear in general. The organ of generation is endowed with a sixth sense, which is seated in its internal skin; that of the stomach and intestines declares the state of those viscera by peculiar sensations. In fine, sensations more or less painful may originate in all parts of the body through accidents or diseases.

Many animals have neither ears nor nostrils; several are without eyes, and some are reduced to the single sense of touch, which is never absent.

The action received by the external organs is continued through the nerves to the central masses of the nervous system, which, in the higher animals, consists of the brain and spinal chord. The more elevated the nature of the animal, the more voluminous is the brain, and the more the sensitive power is concentrated there; in proportion as the animal is placed lower in the scale, the medullary masses are dispersed, and in the lowest genera of all, the nervous substance appears to merge altogether, and blend in the general matter of the body.

That part of the body which contains the brain and the principal organs of sense, is called the head.

When the animal has received a sensation, and which has induced in it an act of volition, it is by [particular] nerves also that this volition is transmitted to the muscles.

The muscles are bundles of fleshy fibres, the contractions of which produce all the movements of the animal body. The extensions of the limbs, and all the lengthenings of parts, are the effect of muscular contractions, equally with flexions and abbreviations. The muscles of each animal are disposed in number and direction according to the movements which it has to execute; and when these movements require to be effected with some vigour, the muscles are inserted into hard parts, articulated one over another, and may be considered as so many levers. These parts are called bones in

the vertebrated animals, where they are internal, and formed of a gelatinous mass, penetrated with molecules of phosphate of lime. In mollusks, crustaceans, and insects, where they are external, and composed of a calcareous or corneous substance that exudes between the skin and epidermis, they are termed shells, crusts, and scales.

The fleshy fibres are attached to the hard parts by means of other fibres of a gelatinous nature, which seem to be a continuation of the former, constituting what are called tendons.

The configuration of the articulating surfaces of the hard parts limits their movements, which are further restrained by cords or envelopes attached to the sides of the articulations, and which are termed ligaments.

It is from the various dispositions of this bony and muscular apparatus, and from the form and proportions of the members which result therefrom, that animals are capable of executing those innumerable movements which enter into walking, leaping, flight, and swimming.

The muscular fibres appropriated to digestion and circulation are independent of the will; they receive nerves, however, but, as we have said, the chief of them exhibit subdivisions and enlargements which appear to have for their object the estrangement of the empire of the ME. It is only in paroxysms of the passions and other powerful mental emotions, which break down these barriers, that the empire of the ME becomes perceptible; and even then its effect is almost always to disorder these vegetative functions. It is also in a state of sickness only that these functions are accompanied by sensations. Digestion is ordinarily performed unconsciously.

The aliment, divided by the jaws and teeth, or sucked up when liquids constitute the food, is swallowed by the muscular movements of the back part of the mouth and throat, and deposited in the first portion of the alimentary canal, usually expanded into one or more stomachs; it there is penetrated with juices proper to dissolve it. Conducted thence along the rest of the canal, it receives other juices destined to complete its preparation. The parietes of the canal have pores which extract from this alimentary mass its nutritious portion, and the useless residue is rejected as excrement.

The canal in which this first act of nutrition is performed, is a continuation of the skin, and is composed of similar layers; even the fibres which encircle it are analogous to those which adhere to the internal surface of the skin, called the fleshy pannicle. Throughout the whole interior of this canal there is a transudation, which has some connexion with the cutaneous perspiration, and which becomes more abundant when the latter is suppressed; the skin even exercises an absorption very analogous to that of the intestines.

It is only in the lowest animals that the excrements are rejected by the mouth, and in which the intestine has the form of a sac without issue.

Among those even in which the intestinal canal has two orifices, there are many in which the nutritive juices, absorbed by the coats of the intestine, are immediately diffused over the whole spongy substance of the body: this appears to be the case with the whole class of insects.

But, ascending from the arachnides and worms, the nutritive fluids circulate in a system of confined vessels, the ultimate ramifications of which alone dispense its molecules to the parts that are nourished by it; those particular vessels which convey it are named

arteries, and those which bring it back to the centre of the circulation are termed *veins*. The circulating vortex is sometimes simple, sometimes double, and even triple (includ ing that of the *vena porta*) ; the rapidity of its movements is often aided by the contractions of a certain fleshy apparatus denominated *hearts*, and which are placed at one or the other centres of circulation, and sometimes at both of them.

In the red-blooded vertebrated animals, the nutritive fluid exudes white or transparent from the intestines, and is then termed *chyle ;* it is poured by particular vessels. named *lacteals*, into the venous system, where it mingles with the blood. Vessels resembling these lacteals, and forming with them what is known as the lymphatic system, also convey to the venous blood the residue of the nutrition of the parts and the products of cutaneous absorption.

Before the blood is proper to nourish the several parts, it must experience from the ambient element, by respiration, the modification of which we have already spoken. In animals which have a circulation, a portion of the vessels is destined to carry the blood into organs, where they spread over an extensive surface, that the action of the ambient element might be increased. When this element [or medium] is the air, the surface is hollow, and is called *lungs ;* when water, it is salient, and termed *gills*.* There are always motive organs disposed for propelling the ambient element into, or upon, the respiratory organ.

In animals which have no circulation, the air is diffused through every part of the body by elastic vessels, named *tracheæ ;* or water acts upon them, either by penetrating through vessels, or by simply bathing the surface of the skin.

The blood which is respired is qualified for restoring the composition of all the parts, and to effect what is properly called nutrition. It is a great marvel that, with this facility which it has of becoming decomposed at each point, it should leave precisely the species of molecule which is there necessary ; but it is this wonder which constitutes the whole vegetative life. For the nourishment of the solids, we see no other arrangement than a great subdivision of the extreme arterial ramifications ; but for the production of liquids, the apparatus is more complex and various. Sometimes the extremities of the vessels simply spread over large surfaces, whence the produced fluid exudes ; sometimes it oozes from the bottom of little cavities. Very often, before these arterial extremities change into veins, they give rise to particular vessels that convey this fluid, which appears to proceed from the exact point of union between the two kinds of vessels ; in this case, the blood-vessels and these latter termed *especial*, form, by their interlacement, the bodies called *conglomerate* or *secretory glands*.

In animals that have no circulation, and particularly insects, the nutritive fluid bathes all the parts ; each of them draws from it the molecules necessary for its sustenance : if it be necessary that some liquid be produced, the appropriate vessels float in the nutritive fluid, and imbibe from it, by means of their pores, the constituent elements of that liquid.

It is thus that the blood incessantly supports all the parts, and repairs the alterations which are the continual and necessary consequence of their functions. The

* It may be remarked here, that, in strictness of language, no animals respire water, but the air which is suspended in water, and which has been ascertained to contain more oxygen than that of the free atmosphere. The elements of water, it should be remembered, are chemically combined, while those of air are only mechanically mixed. To obtain oxygen from the one, therefore, decomposition is required ; rom the other, no disunion. The only distinction, then, in the respiration of animals is, that some breathe the free air, and are supplied with lungs, and others that diffused in water, and have therefore gills : but even this difference, however, is more apparent than real, as in all cases the respiratory surface requires to be moist or wet, in order to perform its function. Deprive water of its air by boiling it and it cannot support life.—ED.

general ideas which we form respecting this process are tolerably clear, although we have no distinct or detailed notion of what passes at each point; and for want of knowing the chemical composition of each part with sufficient precision, we cannot render an exact account of the transformations necessary to produce it.

Besides the glands which separate from the blood those fluids which perform some office in the internal economy, there are some which detach others from it that are to be totally rejected, either simply as superfluities, such as the urine, which is produced by the kidneys, or for some use to the animal, as the ink of the cuttle, and the purple matter of various other mollusks, &c.

With respect to generation, there is one process or phenomenon infinitely more difficult to conceive than that of the secretions; it is the production of the germ. We have seen even that it may be regarded as little less than incomprehensible; but, the existence of the germ once admitted, generation presents no particular difficulty: so long as it adheres to the parent, it is nourished as if it were one of its organs*; and when it detaches itself, it has its own proper life, which is essentially similar to that of the adult.

The germ, the embryo, the fœtus, and the new-born animal, have in no instance, however, precisely the same form as the adult, and the difference is sometimes so great, that their assimilation merits the name of *metamorphosis*. Thus, no one not previously aware of the fact, would suppose that the caterpillar is to become a butterfly.

All living beings are more or less metamorphosed in the course of their growth, that is to say, they lose certain parts, and develope others. The antennæ, wings, and all the parts of the butterfly were inclosed within the skin of the caterpillar; this skin disappears along with the jaws, feet, and other organs that do not remain in the butterfly. The feet of the frog are inclosed by the skin of the tadpole: and the tadpole, to become a frog, loses its tail, mouth, and gills. The infant likewise, at birth, loses its placenta and envelope; at a certain age its thymous gland almost disappears; and it acquires by degrees its hair, teeth, and beard. The relative size of its organs alters, and its body increases proportionally more than its head, its head more than its internal ear, &c.

The place where these germs are found, the assemblage of them, is named the *ovary*; the canal through which, when detached, they are carried forward, the *oviduct*; the cavity in which, in many species, they are obliged to remain for a longer or shorter period before birth, the *matrix* or *uterus*; the exterior orifice through which they pass into the world, the *vulva*. When there are sexes, the male sex fecundates; the germs appearing in the female. The fecundating liquor is named *semen*; the glands which separate it from the blood, *testicles*; and, when it is necessary that it should be introduced into the body of the female, the intromittent organ is called a *penis*.

RAPID EXPOSITION OF THE INTELLECTUAL FUNCTIONS OF ANIMALS.

The impression of external objects on the ME, the production of a sensation, of an image, is a mystery impenetrable to our intellect; and materialism an hypothesis, so much the more conjectural, as philosophy can furnish no direct proof of the actual

* Germs have been detected in the ovaria of a human fœtus.—ED.

existence of matter. But the naturalist should examine what appear to be the material conditions of sensation; he should trace the ulterior operations of the mind, ascertain to what point they reach in each being, and assure himself whether they are not subject to conditions of perfection, dependent on the organization of each species, or on the momentary state of each individual body.

For the ME to perceive, there must be an uninterrupted nervous communication between the external sense and the central masses of the medullary system. Hence it is only when a modification is experienced by these masses that the ME perceives: there may also be real sensations, without the external organ being affected, and which originate either in the nervous passage, or in the central mass itself; such are dreams and visions, or certain accidental sensations.

By central masses, we mean a part of the nervous system, which is more circumscribed as the animal is more perfect. In man, it consists exclusively of a limited portion of the brain; but in reptiles, it includes the brain and the whole of the medulla, and each of their parts taken separately; so that the absence of the entire brain does not prevent sensation. In the inferior classes this extension is still greater.

The perception acquired by the ME, produces the image of the sensation experienced. We trace to without the cause of that sensation, and thus acquire the *idea* of the object which produces it. By a necessary law of our intelligence, all the ideas of material objects are in time and space.

The modifications experienced by the medullary masses leave impressions there, which are reproduced, and recall to mind images and ideas; this is *memory*, a corporeal faculty that varies considerably, according to age and health.

Ideas that are similar, or which have been acquired at the same time, recall each other; this is the *association of ideas*. The order, extent, and promptitude of this association constitute the perfection of memory.

Each object presents itself to the memory with all its qualities, or with all its accessory ideas.

Intellect has the power of separating these accessory ideas of objects, and of combining those that are alike in several different objects under one *general idea*, the prototype of which nowhere really exists, nor presents itself in an isolated form; this is *abstraction*.

Every sensation being more or less agreeable or disagreeable, experience and repeated essays show promptly what movements are required to procure the one and avoid the other; and with respect to this, the intellect abstracts itself from general rules to direct the will.

An agreeable sensation being liable to consequences that are not so, and *vice versâ*, the subsequent sensations become associated with the idea of the primitive one, and modify the general rules abstracted by the intellect; this is *prudence*.

From the application of rules to general ideas, result certain formulæ, which are afterwards adapted easily to particular cases; this is called *reasoning—ratiocination*.

A lively remembrance of primitive and associated sensations, and of the impressions of pleasure and pain that attach to them, constitutes *imagination*.

One privileged being, MAN, has the faculty of associating his general ideas with particular images more or less arbitrary, easily impressed upon the memory, and which serve to recall the general ideas which they represent. These associated images are

what are called *signs;* their assemblage is a *language*. When the language is composed of images that relate to the sense of hearing or *sound*, it is termed *speech*. When its images relate to that of sight, they are called *hieroglyphics*. *Writing* is a suite of images that relate to the sense of sight, by which we represent elementary sounds; and, in combining them, all the images relative to the sense of hearing of which speech is composed: it is, therefore, only a mediate representation of ideas.

This faculty of representing general ideas by particular signs or images associated with them, enables us to retain distinctly in the memory, and to recall without confusion, an immense number, and furnishes to the reasoning faculty and the imagination innumerable materials, and to individuals the means of communication, which cause the whole species to participate in the experience of each individual; so that no bounds seem to be placed to the acquisition of knowledge: this is the distinctive character of human intelligence.*

The most perfect animals are infinitely below man in their intellectual faculties; but it is, nevertheless, certain that their intelligence performs operations of the same kind. They move in consequence of sensations received, are susceptible of durable affections, and acquire by experience a certain knowledge of things, by which they are governed independently of actual pain and pleasure, and by the simple foresight of consequences.† When domesticated, they feel their subordination, know that the being who punishes them may refrain from doing so if he will, and when sensible of having done wrong, or behold him angry, they assume a suppliant air. In the society of man they become either corrupted or improved, and are susceptible of emulation and jealousy: they have among themselves a natural language, which, it is true, expresses only their momentary sensations; but man teaches them to understand another, much more complicated, by which he makes known to them his will, and causes them to execute it.

In short, we perceive in the higher animals a certain degree of reason, with all its consequences, good and bad, and which appears to be about the same as that of children before they have learned to speak. In proportion as we descend to the animals more removed from man, these faculties become enfeebled; and, in the lowest classes, we find them reduced to signs, at times equivocal only, of sensibility, that is to say, to a few slight movements to escape from pain. Between these two extremes, the degrees are endless.

In a great number of animals, however, there exists a different faculty of intelligence, which is named *instinct*. This prompts them to certain actions necessary to the preservation of the species, but often altogether foreign to the apparent wants of individuals; frequently, also, very complicated, and which, to be ascribed to intelligence, would suppose a foresight and knowledge in the species that execute them infinitely superior to what can be admitted. These actions, the result of instinct, are not the effect of imitation, for the individuals that perform them have often never seen them performed by others: they are not proportioned to the ordinary intelligence, but become more singular, more wise, more disinterested, in proportion as the animals belong to less elevated classes, and are, in all the rest of their actions, more dull and

* Linnæus defined the human being to be a "self-knowing animal;" which is a bold assumption, taken either way.—Ed.

† That is to say, they obviously remark coincidences and sequences; but it is doubtful whether any of them can mentally trace remote causes, amid the complication of phenomena. It is with man in his least civilized state that they should be compared.—Ed.

stupid. They are so truly the property of the species, that all its individuals perform them in the same way, without any improvement.

Thus the working bees have always constructed very ingenious edifices, agreeably to the rules of the highest geometry, and destined to lodge and nourish a posterity not even their own. The wasps and the solitary bees also form very complicated nests, in which to deposit their eggs. From this egg issues a grub, which has never seen its parent, which is ignorant of the structure of the prison in which it is confined, but which, once metamorphosed, constructs another precisely similar.

In order to have a clear idea of instinct, it is necessary to admit that these animals have innate and perpetual images or sensations in the sensorium, which induce them to act as ordinary and accidental sensations commonly do. It is a sort of dream or vision that ever haunts them, and may be considered, in all that relates to instinct, as a kind of somnambulism.

Instinct has been granted to animals as a supplement for intelligence, to concur with it, and with force and fecundity, to the preservation, in a proper degree, of each species.

There is no visible mark of instinct in the conformation of the animal; but intelligence, so far as has been observed, is in constant proportion to the relative size of the brain, and particularly of its hemispheres.*

OF METHOD, AS APPLIED TO THE ANIMAL KINGDOM.

After what we have said respecting methods in general, there remains to ascertain which are the most influential characters of animals, that should serve as the basis of their primary divisions. It is evident they should be those which are drawn from the animal functions; that is to say, from the sensations and movements; for not only do both these make the being an animal, but they establish, in a manner, its degree of animality.

Observation confirms this position, by showing that their degrees of developement and complication accord with those of the organs of the vegetative functions.

The heart and the organs of the circulation form a kind of centre for the vegetative functions, as the brain and trunk of the nervous system do for the animal

* One of the most curious phenomena of instinct is the transmission of instilled habits by generation, as in the instance of high-bred pointer and setter dogs, often requiring no training to fit them for their particular modes of indicating game. Propensities are similarly hereditary in the human species; but innate knowledge, as a substitute for individually acquired experience, is peculiar to brutes, which, for the most part, are thrown upon their own resources, before they have had time or opportunities to gain the necessary information to serve as a guide for the regulation of their conduct. All the higher animals, except the human species, appear to recognize their natural foes intuitively, to know even where their hidden weapons lie, also where they (and likewise themselves) are most vulnerable, and they endeavour to use their own peculiar weapons before these are developed. If incapable of resistance, they commonly have recourse to stratagem; *thus a brood of newly-hatched partridges will instantly cower motionless* at sight of an object of distrust, the intent of which must be, that the close similarity of their colour to that of the surface should cause them to be overlooked. Predatory animals, again, which immolate victims capable of dangerous resistance, instinctively endeavour always to attack a vital part, so as to effect their purpose speedily, and with least hazard to themselves; but those which prey on feeble and defenceless animals attack indiscriminately. Many astonishing manifestations of the instinctive faculty occur respecting the manner in which the food is obtained; and in the ant and some rodent quadrupeds, which store up grain, the embryo of every seed is destroyed, to prevent germination.

The seasonal migrative impulse which recurs in some animals is among the most incomprehensible of instinctive phenomena, as it is shown to be, in various cases, independent of food or temperature, though the latter, in particular, exercises some influence on its developement, as does also the state of the sexual organs in spring. The guiding principle of migration is equally mysterious,—that which enables a bird of passage to return periodically to its former haunts, to the same locality (both in winter and summer), which it had previously occupied; and the young also to the place of their nativity. This principle is farther evinced in the return of pigeons, &c. to their accustomed place of abode from indefinite distances, and by a straighter and more direct route than that by which they had been removed. It appears, likewise, to be manifested in somnambulism, and, perhaps, in some other affections of the human body; but the sexual and parental instincts are those which are *chiefly cognizable in civilized man*kind.

One curious fact connected with the migrative propensity is, that the same species is sometimes permanently resident in one locality, and migratory in another. Thus the robin, which is stationary in Britain, leaves Germany in the autumn; which would seem to indicate that the erratic habit may have originated (in this instance) from necessity, and in course of time have become regular and transmissible, independently of external causes. Migratory animals, however, may commonly be distinguished from others of the same genus, by their superior structural powers of locomotion.—Ed.

functions. Now, we see these two systems degrade and disappear together. In the lowest of animals, where the nerves cease to be visible, there are no longer distinct fibres, and the organs of digestion are simply excavated in the homogeneous mass of the body. In insects, the vascular system disappears even before the nervous one; but, in general, the dispersion of the medullary masses accompanies that of the muscular agents: a spinal chord, on which the knots or ganglions represent so many brains, corresponds to a body divided into numerous rings, and supported by pairs of members distributed along its length, &c.

This correspondence of general forms, which results from the arrangement of the organs of motion, the distribution of the nervous masses, and the energy of the circulating system, should serve then for the basis of the primary sections to be made in the animal kingdom. We will afterwards ascertain, in each of these sections, what characters should succeed immediately to these, and form the basis of the primary subdivisions.

GENERAL DISTRIBUTION OF THE ANIMAL KINGDOM INTO FOUR GREAT DIVISIONS.

If the animal kingdom be considered with reference to the principles which we have laid down, and, divesting ourselves of the prejudices founded on the divisions formerly admitted, we regard only the organization and nature of animals, and not their size, utility, the more or less knowledge which we have of them, nor any other accessory circumstances, it will be found that there exist four principal forms, four general plans, if it may be thus expressed, on which all animals appear to have been modelled, and the ulterior divisions of which, under whatever title naturalists may have designated them, are merely slight modifications, founded on the developement or addition of certain parts, which produce no essential change in the plan itself.

In the first of these forms, which is that of man, and of the animals which most resemble him, the brain and the principal trunk of the nervous system are inclosed in a bony envelope, which is formed by the cranium and the vertebræ: to the sides of this medial column are attached the ribs, and the bones of the limbs, which compose the framework of the body: the muscles generally cover the bones, the motions of which they produce, and the viscera are contained within the head and trunk. Animals of this form we shall denominate

VERTEBRATE ANIMALS (*Animalia vertebrata*).

They have all red blood, a muscular heart, a mouth furnished with two jaws, placed one either before or above the other, distinct organs of sight, hearing, smell, and taste, situated in the cavities of the face; never more than four limbs; the sexes always separated; and a very similar distribution of the medullary masses, and of the principal branches of the nervous system.

On examining each of the parts of this great series of animals more closely, there may always be detected some analogy, even in those species which are most remote from one another; and the gradations of one single plan may be traced from man to the last of fishes.

In the second form there is no skeleton; the muscles are attached only to the skin,

which constitutes a soft, contractile envelope, in which, in many species, are formed stony plates, called shells, the production and position of which are analogous to that of the mucous body; the nervous system is contained within this general envelope, together with the viscera, and is composed of several scattered masses, connected by nervous filaments, and of which the principal, placed over the œsophagus, bears the name of brain. Of the four senses, the organs of those of taste and vision only can be distinguished; the latter of which are even frequently wanting. A single family alone presents organs of hearing. There is always, however, a complete system of circulation, and particular organs for respiration. Those of digestion and of the secretions are little less complicated than in the vertebrated animals. We will distinguish the animals of this second form by the appellation of

MOLLUSCOUS ANIMALS (*Animalia mollusca*).

Although the general plan of their organization is not so uniform, as regards the external configuration of the parts, as that of the vertebrates, there is always an equal degree of resemblance between them in the essential structure and the functions.

The third form is that observed in insects, worms, &c. Their nervous system consists of two long chords running longitudinally through the abdomen, dilated at intervals into knots or ganglions. The first of these knots, placed over the œsophagus, and called brain, is scarcely any larger than those which are along the abdomen, with which it communicates by filaments that encircle the œsophagus like a collar. The envelope of their trunk is divided by transverse folds into a certain number of rings, of which the teguments are sometimes hard, sometimes soft, but to the interior of which the muscles are always attached. The trunk often bears on its sides articulated limbs, but is frequently unfurnished with them. We will bestow on these animals the term

ARTICULATE ANIMALS (*Animalia articulata*).

It is among these that the passage is observed from the circulation in closed vessels, to nutrition by imbibition, and the corresponding transition from respiration in circumscribed organs, to that effected by tracheæ or air-vessels distributed through the body. The organs of taste and vision are the most distinct in them, a single family alone presenting that of hearing. Their jaws, when they have any, are always lateral.

Lastly, the fourth form, which embraces all those animals known under the name of *Zoophytes*, may be designated

RADIATE ANIMALS (*Animalia radiata*).

In all the preceding, the organs of sense and motion are arranged symmetrically on the two sides of an axis. There is a posterior and an anterior dissimilar face. In this last division, they are disposed as rays round a centre; and this is the case, even when they consist of but two series, for then the two faces are alike.* They approximate to the homogeneity of plants, having no very distinct nervous system, nor organs of particular senses: there can scarcely be perceived, in some of them, the vestiges of a

* M. Agassiz has expressed a different opinion. See *Radiata*.—ED.

circulation; their respiratory organs are almost always on the surface of the body; the greater number have only a sac without issue, for the whole intestine; and the lowest families present only a sort of homogeneous pulp, endowed with motion and sensibility.*

["The necessity," writes Mr. Owen, "for a dismemberment of the *Radiata* of Cuvier, which Rudolphi justly calls a chaotic group†, has been felt, and directly or indirectly expressed, by most naturalists and comparative anatomists.‡ It is impossible, indeed, to predicate a community of structure in either the locomotive, excretive, digestive, sensitive, or generative systems, with respect to this division, as it now stands in the *Règne Animal.* * * *

"Taking the nervous system as a guide, the *Radiata* of Cuvier will be found to resolve themselves into two natural groups, of which the second differs in the absence or obscure traces of nervous filaments from the higher division, in which these are always distinctly traceable, either radiating from an oral ring, or distributed in a parallel longitudinal direction, according to the form of the body.

"These different conditions of the nervous system are accompanied by corresponding modifications of the muscular, digestive, and vascular systems; and a negative character, applicable to the higher division of Cuvier's *Radiata,* may be derived from the generative system."§

It is only in the lower-organized of these divisions, to which the term

ACRITE ANIMALS (*Animalia acrita*)

has been applied by Macleay, also that of *Protozoa* and *Oozoa* by Carus (from the circumstance of its members being analogous to the ova or germs of the higher classes), that the alimentary cavity and sanguiferous canals are destitute of proper parietes, being simple excavations or passages in the granular pulp of the body: for in the *Nematoneura* (a name applied to the higher division of Cuvier's *Radiata* by Owen), the digestive organ is provided with a proper muscular tunic, and floats in an abdominal cavity: and those classes which manifest a circulating system distinct from the digestive tube possess vessels with proper parietes, distinguishable into arteries and veins.

No nematoneurous class presents an example of generation by spontaneous fision or gemmation, but these modes of reproduction are common in the acrite division. Some of the latter, however, are oviparous; and in a few the sexes are separate.]

* Before my time, modern naturalists divided all invertebrated animals into two classes, the Insects and Worms. I was the first to attack this method, and presented another division, in a Memoir read before the Natural History Society of Paris, on the 10th of May, 1795, and printed in the *Décade Philosophique,* in which I marked the characters and limits of the Mollusks, Crustaceans, Insects, Worms, Echinoderms, and Zoophytes. I distinguished the red-blooded worms, or Annelides, in a memoir read before the Institute on the 31st of December, 1801. And finally, in a Memoir read before the Institute in July, 1812, and printed in the *Annales du Mus. d'Hist. Nat.,* tom. xix., I distributed these various classes under three grand divisions, each of which is comparable to that of the vertebrate animals.

† *Synopsis Entozoorum,* p. 572.

‡ Lamarck observes:—"The *Apathetic* Animals," (as he terms the *Acrita,*) "have been very improperly called *Zoophytes;* as their nature is completely animal, and in no respect vegetable. The denomination of *Rayed Animals* is also objectionable, as it applies only to a portion of them.—*Anim. sans Vertèbres,* i. p. 890.

§ *Cyclopædia of Anatomy and Physiology,* Art. *Acrita;* from which the succeeding passages are also abridged.—ED.

FIRST GREAT DIVISION OF THE ANIMAL KINGDOM.

THE VERTEBRATE ANIMALS.

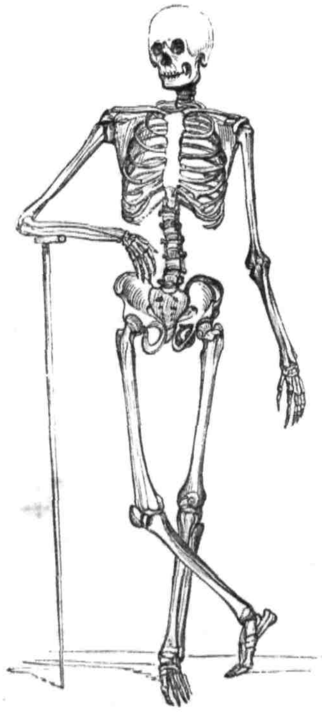

Fig. 1.

The bodies and limbs of these being supported by a frame-work composed of connected pieces moveable upon each other, they have the more precision and vigour in their movements: the solidity of this support permits of their attaining considerable size, and it is among them that the largest animals are found.

Their more concentrated nervous system, and the greater volume of its central portions, impart more energy and more stability to their sentiments, whence result *superior intelligence and perfectibility*.

Their body always consists of a head, trunk, and members.

The head is formed by the cranium, which incloses the brain, and by the face, which is composed of the two jaws and the receptacles of the organs of sense.

Their trunk is supported by the spine of the back and the ribs.

The spine is composed of vertebræ moveable upon each other, of which the first supports the head, and which have an annular perforation, forming together a canal, wherein is lodged that medullary production from which the nerves arise, and which is called the spinal marrow.

The spine, most commonly, is continued into a tail, extending beyond the hinder limbs.

The ribs are semicircles, which protect the sides of the cavity of the trunk: they are articulated at one extremity to the vertebræ, and are ordinarily attached in front to the breast-bone; but sometimes they only partly encircle the trunk, and there are genera in which they are hardly visible.

There are never more than two pairs of limbs; but sometimes one or the other is wanting, or even both: their forms vary according to the movements which they have to execute. The anterior limbs may be organized as hands, feet, wings, or fins; the posterior as feet, or instruments for swimming.

The blood is always red, and appears to have a composition proper for sustaining that energy of sentiment and vigour of muscles, but in different degrees, which correspond to the amount of respiration, from which originates the subdivision of the vertebrate animals into four classes.

The external senses are always five in number, and reside in two eyes, two ears, two nostrils, the teguments of the tongue, and those of the body generally. Certain species, however, have the eyes obliterated.

The nerves reach the medulla through perforations of the vertebræ, or of the cranium: they all seem to unite with this medulla, which, after crossing its filaments, expands to form the various lobes of which the brain is composed, and terminates in the two medullary arches (*voûtes*) termed hemispheres, the volume of which corresponds to the amount of intelligence.

There are always two jaws, the principal motion of which is in the lower one, which rises and falls; the upper is oftentimes entirely fixed: both of them are almost always armed with teeth, excrescences of a peculiar nature, the chemical composition of which is very similar to that of bone, but which grows by layers and transudations; one entire class, however, (that of birds,) has the jaws invested with horn*, and the group of tortoises, in the class of reptiles, is in the same predicament.

The intestinal canal is continued from the mouth to the anus, undergoing various inflexions, and several enlargements and contractions; having also appendages, and receiving solvent fluids, one of which, the saliva, is discharged into the mouth: the others, which flow into the intestine only, have various names; the two principal are the juices of the gland called the pancreas [or *sweet-bread*], and the bile [or *gall*], which is the product of another very large gland, named the liver.

While the digested aliment is traversing its canal, that portion of it which is proper for nutrition, and is termed the chyle, is absorbed by particular vessels, named lacteals, and carried into the veins; the residue of the nutriment of the parts is also carried into the veins by vessels analogous to the lacteals, and forming with them one same system, designated the *lymphatic system*.†

The veins return to the heart the blood which has served to nourish the parts, together with the chyle and lymph with which it has been renewed; but this blood is obliged to pass, either wholly or in part, into the organ of respiration, to regain its arterial nature, previous to being again dispersed over the system by the arteries. In the three first classes, this organ of respiration consists of lungs, that is, an assemblage of cells into which air penetrates. In fishes only, and in some reptiles while young, it consists of gills, or a series of laminæ between which water passes.

In all the vertebrate animals, the blood which furnishes the liver with the materials of the bile is venous blood, which has circulated partly in the parietes of the intestines, and partly in a peculiar body named the *spleen*, and which, after being united in a trunk called the *vena porta*, is again subdivided at the liver.

* M. Geoffroy St. Hilaire has described a structure in the bill of birds which presents some approach to a dentary system. In a fœtus of a Parroquet nearly ready for hatching, he found that the margins of the bill were beset with tubercles arranged in a regular order, and having all the exterior appearance of teeth; these tubercles were not, indeed, implanted in the jaw-bones, but formed part of the exterior sheath of the bill. Under each tubercle, however, there was a gelatinous pulp, analogous to the pulps which secrete teeth, but resting on the edge of the maxillary bones, and every pulp was supplied by vessels and nerves traversing a canal in the substance of the bone. These tubercles form the first margins of the mandibles, and their remains are indicated by canals in the horny sheath, subsequently formed, which contain a softer material, and which commence from small foramina in the margin of the bone. In certain other birds (as the Mergansers) also, the lateral edges of the bill are provided with horny processes or laminæ secreted by distinct pulps, and analogous in this respect to the whalebone laminæ of the Whales, which are toothless *Mammalia*, as are also the ant eaters and *Monotremata*: it is further remarkable that the rudiments of dentition occur in the *fœtus* of the toothless Whales. —ED.

† The lymphatic vessels are also the media of cutaneous transudation.—ED.

All these animals have a particular secretion, which is that of *urine*, and which is elaborated in two large glands attached to the sides of the spine of the back, and called *kidneys:* the liquid which these glands secrete, accumulates most commonly in a reservoir named the *bladder*.

The *sexes* are separate, and the female has always one or two ovaries, from which the eggs are detached at the instant of conception. The male fecundates them with the seminal fluid; but the mode varies greatly. In most of the genera of the three first classes, it requires an intromission of the fluid; in some reptiles, and in most of the fishes, it takes place after the exit of the eggs.

SUBDIVISION OF THE VERTEBRATE ANIMALS INTO FOUR CLASSES.

We have seen to what extent vertebrate animals resemble each other: they present, however, four great subdivisions or classes, characterized by the kind or power of their movements, which depend themselves on the quantity of respiration, inasmuch as it is from this respiration that the muscular fibres derive the energy of their irritability.

The quantity of respiration depends upon two agents: the first is the relative quantity of blood which presents itself in the respiratory organ in a given instant of time; the second, the relative amount of [free] oxygen which enters into the composition of [or is dispersed through] the ambient fluid. The quantity of the former depends upon the disposition of the organs of respiration and of circulation.

The organs of the circulation may be double, so that all the blood which is brought back from the various parts of the body by the veins, is forced to circulate through the respiratory organ before returning by the arteries; or they may be simple, so that a portion only of the blood is obliged to pass through the respiratory organ, the remainder returning to the body without having been subjected to respiration.

The latter is the case with reptiles. The amount of their respiration, and all the qualities which depend on it, vary according to the quantity of blood which is thrown into the lungs at each pulsation.

Fishes have a double circulation, but their organ of respiration is formed to execute its function through the medium of water; and their blood is only acted upon by that small portion of oxygen which is dissolved or mingled in water; so that the quantity of their respiration is, perhaps, less than that of reptiles.

In mammalians, the circulation is double, and the aërial respiration simple, that is, it is performed in the lungs only: their quantity of respiration is, therefore, superior to that of reptiles, on account of the form of their respiratory organ, and to that of fishes, from the nature of their surrounding medium.

But the quantity of respiration in birds is even superior to that of quadrupeds, since they have not only a double circulation and an aërial respiration, but also respire by many other cavities besides the lungs, the air penetrating throughout their bodies, and bathing the branches of the aorta, or main artery of the body, as well as those of the pulmonary artery.*

Hence result the four kinds of progression to which the four classes of the vertebrate animals are more particularly destined. The quadrupeds, in which the quantity of

* In Batrachian reptiles (frogs, newts, &c.), respiration is to a certain extent performed over the whole outer skin; which, on this account, requires to be always moist. Hence, as there can be no muscular action without previous respiration, the chemical change effected by which is needed to develope the requisite nervous or vital energy, those animals of this group which in the adult state have lungs and not gills, but which pass the winter in a torpid state under water, are enabled to resuscitate in spring.—ED.

respiration is moderate, are generally formed to walk and run with precision and vigour; the birds, in which it is greater, have the muscular energy and lightness necessary for flight; the reptiles, where it is diminished, are condemned to creep, and many of them pass a portion of their life in a state of torpor; the fishes, in fine, to execute their movements, require to be supported in a fluid specifically almost as heavy as themselves.*

All the circumstances of organization proper to each of these four classes, and especially those which refer to motion and the external senses, have a necessary relation with these essential characters.

The class of mammalians, however, has peculiar characters in its viviparous mode of generation, in the manner in which the fœtus is nourished in the womb by means of the placenta, and in the mammæ by which they suckle their young.

The other classes are, on the contrary, oviparous; and if we place them together, in opposition to the first, there will be perceived numerous resemblances which announce, on their part, a special plan of organization, subordinate to the great general plan of all the vertebrates.

THE FIRST CLASS OF VERTEBRATE ANIMALS.

MAMMALIA.

Mammalians require to be placed at the head of the animal kingdom, not only because this is the class to which we ourselves belong, but also because it is that which enjoys the most numerous faculties, the most delicate sensations, the most varied powers of motion, and in which all the different qualities seem together combined to produce a more perfect degree of intelligence,—the one most fertile in resources, most susceptible of perfection, and least the slave of instinct.

As their quantity of respiration is moderate, they are in general designed for walking on the ground, but with vigorous and continued steps. Consequently, all the articulations of their skeleton have very precise forms, which rigorously determine their motions.

Some of them, however, by means of lengthened limbs and extended membranes, raise themselves in the air; others have the limbs so shortened, that they can employ them with effect only in water; but they do not the more on this account lose the general characters of the class.

* To descend to particular cases, however, it would appear that species may be framed on almost every type, even very subordinate types, for any particular mode of life. Thus, to illustrate briefly, the bats, which are true mammalians, are modified for aërial progression like birds; and the whales, other mammalians, have a fish-like exterior, being designed to live exclusively in water: so there are birds which are utterly incapable of flight; some, as the ostrich, adapted to scour the plains, like a quadruped; others, as the penguins, whose only sphere of activity is in the water: the pterodactyle affords an example of a genus of flying reptiles, the fossil remains of which only have been discovered. Descending to lower groups, we find among birds, a genus of thrushes (*Cinclus*), which seeks its subsistence under water; and another of totipalmate water-fowl (*Tachypetes*), which neither swims nor dives. Such deviations, however, from the general character of their allied genera, have no intrinsical relation to the groups which they approximate in habit,—nought that can be regarded as an intentional or designed *representation* of them, as has sometimes been imagined: for it is evident, that if species based on two different plans of organization are respectively modified to perform the same office in the economy of nature, they must necessarily resemble, to a certain extent, superficially, as a consequence of that adaptation; while there are many cases also in each class which cannot well be represented in some others, as that of the mole among quadrupeds, which has no counterpart or correspondent group in the class of birds. Habit, or mode of life, has indeed nothing whatever to do with the physiological relations of organisms, which afford the only legitimate basis of classification; and those special modifications to particular habits, which, occurring alike in any class, superinduce a resemblance in superficial characters only, constitute what has been well distinguished by the term *analogy*, as opposed to *affinity*.—Ed.

They have all the upper jaw fixed to the skull, and the lower composed of two pieces only, articulated by a projecting condyle to a fixed temporal bone; the neck consists of seven vertebræ, one single species excepted, which has nine*; the anterior ribs are attached in front, by cartilage, to a sternum formed of a certain number of pieces placed in a row; their fore-limb commences in a blade-bone, which is not articulated, but merely suspended in the flesh, often resting on the sternum by means of an intermediate bone, called a clavicle. This extremity is continued by an arm, a fore-arm, and a hand, the last composed of two ranges of small bones, called a wrist or carpus, of another range of bones termed metacarpus, and of digits or fingers, each of which consists of two or three bones, named phalanges.

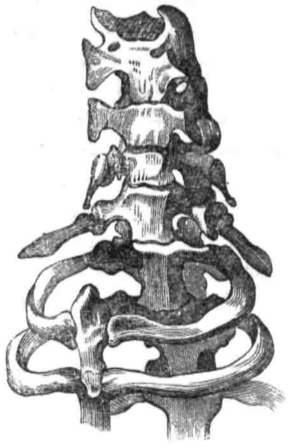

Fig. 2.

Excepting the *Cetacea*, they have all the first part of the hinder extremity fixed to the spine, and forming a girdle or pelvis, which, in youth, consists of three pairs of bones,— the ilium, which is attached to the spine, the pubis, which forms the fore part of the girdle, and the ischium, which constitutes the hind part. At the point of union of these three bones is situate the cavity with which the thigh is articulated, to which, in its turn, is attached the leg, formed of two bones, the tibia and fibula: this extremity is terminated by the foot, which is composed of parts analogous to those of the hand, namely, a tarsus, metatarsus, and digits or toes.

The head of mammalians is always articulated by two condyles upon the atlas, or first vertebra.

Their brain is composed of two hemispheres, united by a medullary layer termed the *corpus callosum*, containing two ventricles, and enveloping the four pairs of tubercles named the *corpora striata*, the *thalami nervorum opticorum*, or beds of the optic nerves, and the *nates* and *testes*. Between the optic beds is a third ventricle, which communicates with a fourth situated under the *cerebellum*, the crura of which always form a transverse prominence under the *medulla oblongata*, called the *pons Varolii*.

Their eye, invariably lodged in its orbit, is protected by two lids and a vestige of a third, and has its crystalline fixed by the ciliary process and its simply cellular sclerotica [or white].

In their ear, there is always found a cavity named the drum, or *tympanum*, which communicates with the back part of the mouth, by a canal termed the trumpet, or Eustachian tube: the cavity itself is closed externally by a membrane called the *membrana tympani*, and contains a chain of four little bones, named the hammer, anvil, orbicular, and stirrup bones; a vestibule, on the entrance of which rests the stirrup-bone, and which communicates with three semicircular canals; and, finally, a *cochlea*, which terminates by one passage in the drum, and by another in the vestibule.

Their cranium subdivides into three portions: the anterior is formed by the two frontal and the ethmoidal bones; the middle, by the parietal bones and the sphenoidal;

* The sloth is alluded to, in which, however, distinct rudiments of ribs are attached to the eighth and ninth as shown in the above figure (*a*, *b*); so that, in reality, this constitutes no exception to the universal rule.—ED.

and the posterior, by the occipital. Between the occipital, the parietal, and the sphenoidal, are interposed the temporal bones, part of which belong properly to the face.

In the fœtus, the occipital bone divides into four parts; the sphenoidal into halves, which subdivide into three pairs of lateral wings; the temporal into three, of which one serves to complete the cranium, another to close the labyrinth of the ear, and the third to form the parietes of its drum, &c. These bony portions [centres of ossification], which are still more numerous in the earliest period of fœtal existence, are united more or less promptly, according to the species, and the bones themselves become finally consolidated in the adult.*

Their face is essentially formed by the two maxillary bones, between which pass the nostrils, and which have the two intermaxillaries in front, and the two palate bones behind; between them descends a single lamina of the ethmoidal bone, named the *vomer;* at the entrance of the nasal canal are the bones proper to the nose; to its external parietes adhere the inferior turbinated bones, which occupy its upper and posterior portion, belonging to the ethmoidal. The jugal or cheek bone unites on each side the maxillary to the temporal bone, and often to the frontal; lastly, the lachrymal bone occupies the inner angle of the orbit, and sometimes a part of the cheek. These bones also present more numerous subdivisions in the embryo.

Their tongue is always fleshy, and attached to a bone termed the hyoidal, which is composed of several pieces, and suspended from the cranium by ligaments.

Their lungs, two in number, divided into lobes, and composed of an infinitude of cells, are always inclosed without adhesion in a cavity formed by the ribs and diaphragm, and lined by the pleura, their organ of voice is always at the upper end of the windpipe; a fleshy elongation, called the *velum palati,* establishes a direct communication between their larynx and nostrils.

Their residence on the surface of the earth exposing them less to the alternations of heat and cold, their body has only a moderate kind of tegument, the hair or fur, and even this is commonly scanty in those of hot climates.†

The cetaceans, which live entirely in water, are the only ones that are altogether deprived of it.

The abdominal cavity is lined with a membrane called the peritonæum; and their intestinal canal is suspended to a fold of it, termed the mesentery, which contains numerous conglomate glands, in which the lacteal vessels ramify: another production of the peritonæum, named the epiploon, hangs in front of and under the intestines.

The urine, retained for some time in the bladder, is discharged, in the two sexes, with very few exceptions, by orifices in the organs of generation.

In all mammalians, generation is essentially viviparous; that is to say, the fœtus, immediately after conception, descends [gradually] into the matrix, inclosed in its envelopes, the exterior of which is named *chorion,* and the interior *amnios;* it fixes itself to the parietes of this cavity by one or more plexus of vessels, termed the placenta, which establishes a communication between it and the mother, by which it receives its nourishment, and probably also its oxygenation; notwithstanding which.

* Here it may be remarked that, descending in the series of vertebrates, the same is observable as in ascending to fœtal life in the higher groups; the progress of developement, in this and other respects, being arrested at different stages of advancement, according to the class, order, and species: the brain for instance, in man, successively assuming the conditions of this organ in fishes, reptiles, birds, the lower and then higher groups of mammalians.—Ed.

† In some monkeys from Sierra Leone, the most torrid region in the world, the hair is much elongated, but thin and coarse, as if designed to protect them from the solar rays.—Ed.

the fœtus of mammalians, at an early period, has a vessel analogous to that which contains the yolk in the oviparous classes, receiving, in like manner, vessels from the mesentery. It has also another external bladder named the allantoid, which communicates with the urinary one by a canal termed the *urachus*.

Conception always requires an effectual coitus, in which the fecundating fluid of the male is thrown into the uterus of the female.

The young are nourished for some time after birth by a fluid peculiar to this class (the milk), which is produced by the mammæ, at the time of parturition, and for as long a period as the young require it. It is from the mammæ that this class derives its name, and, being a character peculiar to it, they distinguish it better than any other that is external.*

DIVISION OF THE CLASS OF MAMMALIA INTO ORDERS.

The variable characters which establish essential differences among the mammalia are taken from the organs of touch, on which depends their degree of ability or address, and from the organs of manducation, which determine the nature of their food, and are connected together, not only with all that relates to the digestive function, but also with a multitude of other differences extending even to their intelligence.

The degree of perfection of the organs of touch is estimated by the number and the mobility of the fingers, and from the greater or less extent to which their extremities are enveloped by the nail or the hoof.

A hoof which envelopes all that portion of the toe which touches the ground, blunts its sensibility, and renders the foot incapable of seizing.

The opposite extreme is where a nail, formed of a single lamina, covers only one of the faces of the extremity of the finger, and leaves the other possessed of all its delicacy.

The nature of the food is known by the grinders, to the form of which the articulation of the jaws universally corresponds.

For cutting flesh, grinders are required as trenchant as a saw, and jaws fitted like scissors, which have no other motion than a vertical one.

For bruising grain or roots, flat-crowned grinders are necessary, and jaws that have a lateral motion: in order that the crowns of these teeth should always be irregular, as in a mill, it is further requisite that their substance should be formed of parts of unequal hardness, so that some may wear away faster than others.

Hoofed animals are all necessarily herbivorous, and have flat-crowned grinders, inasmuch as their feet preclude the possibility of their seizing a living prey.

Animals with unguiculated fingers are susceptible of more variety; their food is of all kinds: and, independently of the form of their grinders, they differ greatly from each other in the mobility and delicacy of their fingers. There is one character with respect to this, which has immense influence on their dexterity, and greatly multiplies its powers; it is the faculty of opposing the thumb to the other fingers for the purpose of seizing small objects, constituting what is properly termed a *hand;* a faculty which

* We shall find, however, in the sequel some doubts on this subject, as regards the family of *Monotremata*. [These doubts have since been removed, inasmuch as the lacteal glands have been detected, with their secretion; though, as in the cetaceans, there appear to be no nipples, simple pressure alone causing the fluid to exude. In the class of birds, a lacteal fluid is secreted by the crops of the parrots and pigeons, which is disgorged into the throats of the young when newly hatched.—ED.]

We have seen, in the *Primaria*, that particular plan of conformation so modified as to enable certain species to fly : in the *Carnaria*, the Seals afford an example of exclusive adaptation to aquatic habits.

It could only have been the desire to maintain a sort of continuous succession, as in the former instance, which induced our author to range the *Marsupiata* next to the *Carnaria*; for they are unquestionably the lowest-organized of mammalians, whence their intrusion so high in the system of the class furnishes another proof of the impropriety of allowing undue importance to particular characters. An order which has a better claim to succeed the *Carnaria*, is that of the fish-like mammalians, or *Cetacea*; but, divested of the herbivorous genera ranged in it by Cuvier, which are strict *Pachydermata*. (It is scarcely necessary to repeat, that modifications which have reference to habit do not necessarily affect the essential relations of organisms).

The *Pachydermata* follow, which, in their turn, must not be regarded as more nearly related to the last, because certain genera of them are analogously adapted for aquatic habits only. We feel compelled to reiterate this general principle, in order to preclude misconception; the sound inference seems to be, that a tendency to general modification for aquatic habits prevails in this part of the system; which certainly helps to indicate what orders should be placed in contiguity, though still not of necessity, even admitting that many analogous cases may be cited in corroboration of a vague index being thus afforded.*

We prefer to arrange the *Ruminantia* next to the *Pachydermata*; then the *Edentata*, and the *Rodentia*; and last of all the *Marsupiata*, including the *Monotremata* of Cuvier, the formerly doubtful points concerning which are now, with slight reservation, finally set at rest.

It will be perceived that this arrangement is tolerably in accordance with the ordinary cerebral developement, and consequent amount of intelligence, of the eight successive orders. Passing on to the Birds, we commence with a higher intellect (in the Parrots) than is manifested in either of the last three, or, perhaps, four orders; which agrees with the general proposition stated at p. 43.]

THE FIRST ORDER OF MAMMALIANS.

BIMANA, OR MAN.

Man forms but one genus, and that genus the only one of its order. As his history is more directly interesting to ourselves, and forms the standard of comparison to which we refer that of other animals, we will treat of it more in detail.

We will rapidly sketch whatever Man offers, that is peculiar in each of his organic systems, amidst all that he has in common with other mammalians; we will describe his principal races and their distinctive characters; and finally point out the natural order of the developement of his faculties, both individual and social.

*For an instance in point, see our remarks on certain conformities of structure observable in the two groups of Parrots and Hawks.

PECULIAR CONFORMATION OF MAN.

The foot of Man is very different from that of Apes: it is large; the leg bears vertically upon it; the heel is expanded beneath; his toes are short, and but slightly flexible; the great toe, longer and larger than the rest, is placed on the same line with and cannot be opposed to them. This foot, then, is proper for supporting the body, but cannot be used for seizing or climbing*, and as the hands are unfitted for walking, Man is the only animal truly *bimanous* and *biped*.

The whole body of Man is modified for the vertical position. His feet, as we have already seen, furnish him with a larger base than those of other mammalians; the muscles which retain the foot and thigh in the state of extension are more vigorous, whence results the swelling of the calf and buttock; the flexors of the leg are attached higher up, which permits of complete extension of the knee, and renders the calf more apparent. The pelvis is larger, which separates the thighs and feet, and gives to the trunk that pyramidal form favourable to equilibrium: the necks of the thigh-bones form an angle with the body of the bone, which increases still more the separation of the feet, and augments the basis of the body. Finally, the head, in this vertical position, is in equilibrium with the trunk, because its articulation is exactly under the middle of its mass.

Were he to desire it, Man could not, with convenience, walk on all fours: his short and nearly inflexible foot, and his long thigh, would bring the knee to the ground; his widely separated shoulders and his arms, too far extended from the median line, would ill support the fore-part of his body; the great indented muscle which, in quadrupeds, suspends the trunk between the blade-bones as a girth, is smaller in Man than in any one among them; the head is heavier, on account of the magnitude of the brain, and the smallness of the sinuses or cavities of the bones; and yet the means of supporting it are weaker, for he has neither cervical ligament, nor are the vertebræ so modified as to prevent their flexure forward; he could therefore only maintain his head in the same line with the spine, and then, his eyes and mouth being directed towards the ground, he could not see before him; the position of these organs is, on the contrary, quite perfect, supposing that he walks erectly.

The arteries which supply his brain, not being subdivided as in many quadrupeds, and the blood requisite for so voluminous an organ being carried to it with too much violence, frequent apoplexies would be the consequence of a horizontal position.

Man, then, is designed to be supported by the feet only. He thus preserves the entire use of his hands for the arts, while his organs of sense are most favorably situated for observation.

These hands, which derive such advantages from their liberty, receive as many more from their structure. Their thumb, longer in proportion than in the apes, increases the facility of seizing small objects; all the fingers, except the annularis [and this to a certain extent], have separate movements, which is not the case in any other animal, not even in the apes. The nails, covering only one side of the extremities of the fingers, form a support to the touch, without in the least depriving it of its delicacy. The arms which support these hands have a solid attachment by their large blade-bone, their strong collar bone, &c.

Man, so highly favoured as to dexterity, is not so with regard to strength. His swiftness in running is much inferior to that of other animals of his size; having neither projecting jaws, nor salient canine teeth, nor crooked nails, he is destitute of offensive armature; and the sides and upper part of his body being naked, unprovided even with hair, he is absolutely

* It is certain, however, that by much practice from early youth, the foot has been known to acquire an amount of dexterity in manual operations, which it would not have been supposed capable of by those whose feet have been enveloped from the time they first walked in close investments. Individuals, in particular, who have been born with the anterior extremities imperfect, have illustrated this practicability the most remarkably. The influence of habit in training even the hand to perform its functions, will be appreciated by those who cannot use their left hand with the same freedom as the right.—ED.

without defensive weapons: lastly, he is of all animals that which is latest to acquire the power necessary to provide for himself.

But this weakness even has been for him another advantage, in obliging him to have recourse to those internal means—to that intelligence which has been awarded to him in so high a degree.

No quadruped approaches him in the magnitude and convolutions of the hemispheres of the brain, that is to say, of that part of this organ which is the principal instrument of the intellectual operations; the posterior portion of the same organ extends backwards, so as to form a second covering to the cerebellum; even the form of the cranium announces this great size of the brain, as the smallness of the face shows how slightly that portion of the nervous system which influences the external senses predominates in him.

These external senses, however, moderate as they all are in Man, are yet extremely delicate and well balanced.

His two eyes are directed forwards; he does not see on two sides at once, like many quadrupeds, which produces more unity in the result of his vision, and concentrates his attention more closely on objects of this kind. The ball and iris of his eye vary but little, which restrains the activity of his sight to limited distances, and to a determined degree of light. The conch of his ear, possessing but little mobility or extent, does not increase the intensity of sounds, notwithstanding which, of all animals, he best distinguishes their intonation. His nostrils, more complicated than those of apes, are less so than those of all other genera; and yet he appears to be the only animal whose sense of smell is sufficiently delicate to be affected by unpleasant odours. Delicacy of smell must influence that of taste; and Man must have a further advantage, in this respect, at least over those animals whose tongues are covered with scales. Lastly, the nicety of his touch results, both from the delicacy of his teguments and the absence of all insensible parts, as well as from the the form of his hand, which is better adapted than that of any other animal for suiting itself to all the small inequalities of surfaces.

Man has a particular pre-eminence in his organ of voice: of all mammalians, he can alone articulate sounds; the form of his mouth and the great mobility of his lips being probably the cause of this. Hence results his most invaluable mode of communication; for of all the signs which can be conveniently employed for the transmission of ideas, variations of sound are those which can be perceived at the greatest distance, and in the most various directions simultaneously.

It seems that even the position of the heart and of the great vessels bears reference to the vertical carriage. The heart is placed obliquely on the diaphragm, and its point inclines to the left, thereby occasioning a distribution of the aorta differing from that of most quadrupeds.

The natural food of Man, judging from his structure, appears to consist principally of the fruits, roots, and other succulent parts of vegetables. His hands afford every facility for gathering them; his short and but moderately strong jaws on the one hand, and his canines being equal only in length to the other teeth, together with his tuberculated molars on the other, would scarcely permit him either to masticate herbage, or to devour flesh, were these condiments not previously prepared by cooking. Once, however, possessed of fire, and those arts by which he is aided in seizing animals or killing them at a distance, every living being was rendered subservient to his nourishment, thereby giving him the means of an indefinite multiplication of his species.

His organs of digestion are in conformity with those of manducation; his stomach is simple, his intestinal canal of mean length, his great intestines well marked, his cœcum short and thick, and augmented by a small appendage, and his liver divided only into two lobes and one small one; his epiploon hangs in front of the intestines, and extends into the pelvis.

To complete this abridged statement of the anatomical structure of Man, necessary for this

Introduction, we will add, that he has thirty-two vertebræ, of which seven belong to the neck, twelve to the back, five to the loins, five to the sacrum, and three to the coccyx. Of his ribs, seven pairs are united to the sternum by elongated cartilages, and are called true ribs; the five following pairs are denominated false ones. His adult cranium consists of eight bones; an occipital (*occipito-basilaire*); two temporal; two parietal; a frontal; an ethmoidal, and a sphenoidal. The bones of his face are fourteen in number; namely, two maxillaries; two jugals, each of which joins the temporal to the maxillary bone of its own side by a sort of handle named the zygomatic arch; two nasal bones; two palatines, behind the palate; a vomer, between the nostrils; two turbinated bones of the nose in the nostrils; two lachrymals in the inner angles of the orbits, and the single bone of the lower jaw. Each jaw has sixteen teeth: four cutting incisors in the middle, two pointed canines at the corners, and ten molars with tuberculated crowns, five on each side, in all thirty-two teeth. His blade-bone has at the extremity of its spine or projecting ridge a tuberosity, named the acromion, to which the clavicle or collar-bone is connected, and over its articulation is a point termed the coracoid process, to which certain muscles are attached. The radius turns completely on the cubitus or ulna, owing to the mode of its articulation with the humerus. The wrist has eight bones, four in each range; the tarsus has seven; those of the remaining parts of the hand and foot may be easily counted by the number of digits.

Enjoying, by means of his industry, uniform supplies of nourishment, Man is at all times inclined to sexual intercourse, without being ever furiously incited. His generative organ is not supported by a bony axis; the prepuce does not retain it attached to the abdomen; but it hangs in front of the pubis: numerous and large veins, which effect a rapid transfer of the blood of his testes to the general circulation, appear to contribute to the moderation of his desires.

The uterus of woman is a simple oval cavity; her mammæ, only two in number, are situated on the breast, and correspond with the facility she possesses of supporting her child upon her arm.

PHYSICAL AND MORAL DEVELOPEMENT OF MAN.

The ordinary produce of the human species is but one child at a birth; for in five hundred cases of parturition, there is only one of twins, and more than that number is extremely rare. The period of gestation is nine months. A fœtus of one month is ordinarily an inch in height; at two months, it is two inches and a quarter; at three months, five inches; at five months, six or seven inches; at seven months, eleven inches; and at nine months, eighteen inches. Those which are born prior to the seventh month usually die. The first or milk teeth begin to appear a few months after birth, commencing with the incisors. The number increases in two years to twenty, which are shed successively from about the seventh year, to be replaced by others. Of the twelve posterior molars, which are permanent, there are four which make their appearance at four years and a half, four at nine years; the last four being frequently not cut until the twentieth year.

The fœtus grows more rapidly in proportion as it approaches the time of birth. The infant, on the contrary, increases always more and more slowly. It has upwards of a fourth of its height when born, attains the half of it at two years and a half, and the three fourths at nine or ten years. By the eighteenth year the growth almost entirely ceases. Man rarely exceeds six feet, and seldom remains under five. Woman is ordinarily some inches shorter.

Puberty manifests itself by external signs, from the tenth to the twelfth year in girls, and from the twelfth to the sixteenth in boys. It arrives sooner in warm climates. Either sex very rarely produces before the epoch of this manifestation.

Scarcely has the body attained its full growth in height, before it commences to increase in bulk; fat accumulates in the cellular tissue. The different vessels become

gradually obstructed; the solids become rigid; and after a life more or less prolonged, more or less agitated, more or less painful, old age arrives, with decrepitude, decay, and death. Man rarely lives beyond a hundred years; and most of the species, either from disease, accidents, or merely old age, perish long before that term.

The child needs the assistance of its mother much longer than her milk, whence results an education intellectual as well as physical, and a durable mutual attachment. The nearly equal number of individuals of the two sexes, the difficulty of supporting more than one wife, when wealth does not supply the want of power, intimate that monogamy is the natural condition of our species; and as, wherever this kind of union exists, the sire participates in the education of his offspring, the length of time required for that education allows the birth of others, whence the natural perpetuity of the conjugal state. From the long period of infantile weakness results domestic subordination, and, consequently, the order of society at large, as the young persons which compose the new families continue to preserve with their parents those tender relations to which they have so long been accustomed. This disposition to mutual assistance multiplies to an almost unlimited extent those advantages previously derived by isolated Man from his intelligence; it has assisted him to tame or repulse other animals, to defend himself from the effects of climate, and thus enabled him to cover the earth with his species.

In other respects, Man appears to possess nothing resembling instinct, no regular habit of industry produced by innate ideas; all his knowledge is the result of his sensations, his observations, or of those of his predecessors. Transmitted by speech, increased by meditation, applied to his necessities and his enjoyments, they have given rise to all the arts. Language and letters, by preserving acquired knowledge, are a source of indefinite perfection to his species. It is thus that he has acquired ideas, and made all nature contribute to his wants.*

There are very different degrees of developement, however, in Man.

The first hordes, compelled to live by hunting and fishing, or on wild fruits, and being obliged to devote all their time to search for the means of subsistence, and not being able to multiply greatly, because that would have destroyed the game, advanced but slowly; their arts were limited to the construction of huts and canoes, to covering themselves with skins, and fabricating arrows and nets; they observed such stars only as served to direct them in their journeys, and some natural objects whose properties were of use to them; they gained the dog for a companion, because he had a natural inclination for the same kind of life. When they had succeeded in taming the herbivorous animals, they found in the possession of numerous flocks a never-failing source of subsistence, and some leisure, which they employed in extending the sphere of their acquirements. Some industry was then employed in the construction of dwellings and the making of clothes; the idea of property was admitted, and, consequently, that of barter, together with wealth and difference of conditions, those fruitful sources of the noblest emulation and the vilest passions; but the necessity of searching for fresh pastures, and of obeying the changes of the seasons, still doomed them to a wandering life, and limited their improvement to a very narrow sphere.

The multiplication of the human species, and its improvement in the arts and sciences, has

* *The numerous structural concurrences, all of which are required to promote the intellectual developement of mankind, are worthy of serious consideration with reference to the unaided faculties of other animals.*

For example, if the superior intelligence of Man were not seconded by his admirable hands (so vastly excelling those of the monkey tribe), by his efficient vocal organ, &c., which are obvious to all as mere physical conformations, indeed, but slight modifications of what occur in other animals,—if, in short, he were reduced in these re- *spects to the condition of the Dog, how effectually would the privation operate to prevent that progressive advancement which, under existing circumstances, is achieved by the human race only.*

But, even grant to Man the use of all his organs, yet deprive him of the accumulated experience of his predecessors, and all mental culture beyond the result of his incidental experience (which in brutes is a *necessary consequence of their imperfect means of communication),* and we perceive how immensely he is indebted also to these accessories.

On the other hand, however, a duly developed brain and commensurate intelligence are required to enable Man to avail himself of the advantages of his structure, for otherwise he appears doomed to remain stationary like a brute (as in the instance of the New Hollanders), even in the midst of civilization. There are also casualties, as the general insecurity of life or property arising from situation or misgovernment, which ordinarily suffice to repel the efforts of advancement, even of the most intelligent races.

It would accordingly, then, appear, that the characteristic traits of human intellect are mainly due to the co-operation of extrinsic causes, and to the accessory aids afforded by physical conformation. —ED.

only been carried to a high degree since the invention of agriculture and the division of the soil into hereditary possessions. By means of agriculture, the manual labour of a portion of society is adequate to the maintenance of the whole, and allows the remainder time for less necessary occupations, at the same time that the hope of acquiring, by industry, a comfortable subsistence for self and posterity, has given a new spring to emulation. The discovery of a representative of property, or a circulating medium, has carried this emulation to the highest degree, by facilitating exchanges, and rendering fortunes more independent and susceptible of being increased; but by a necessary consequence, it has also equally increased the vices of effeminacy and the furies of ambition.

In every stage of the developement of society, the natural propensity to reduce all knowledge to general principles, and to search for the causes of each phenomenon, has produced reflecting men, who have added new ideas to those already accumulated; nearly all of whom, while knowledge was confined to the few, endeavoured to convert their intellectual superiority into the means of domination, exaggerating their merit in the eyes of others, and disguising the poverty of their knowledge by the propagation of superstitious ideas.

An evil more irremediable, is the abuse of physical power; now that Man only can injure Man, he affords the only instance of a species continually at war with itself. Savages dispute their forests, and herdsmen their pastures; and make irruptions, as often as they can, upon the cultivators of the soil, to deprive them of the fruits of their long and painful labours. Even civilized nations, far from being satisfied with their enjoyments, carry on war for the prerogative of pride, or the monopoly of commerce. Hence the necessity of governments to direct the national wars, and to repress or reduce to regular forms the quarrels of individuals.

Circumstances, more or less favourable, have restrained the social condition within limited degrees, or have promoted its developement.

The glacial climates of the north of both continents, and the impenetrable forests of America, are still inhabited by the savage hunter or fisherman. The immense sandy or salt plains of Central Asia and Africa are covered with a pastoral people, and innumerable herds: these half-civilized hordes assemble at the call of every enthusiastic chief, and overrun the cultivated countries that surround them, in which they establish themselves but to become enervated, and to be subjected in their turn to the next invaders. This is the true cause of that despotism, which, in every age, has crushed the industry called forth under the fine climates of Persia, India, and China.

Mild climates, soils naturally irrigated and rich in vegetables, are the natural cradle of agriculture and civilization; and when their position is such as to afford shelter from the incursions of barbarians, talents of every kind are mutually excited; such were formerly (the first in Europe,) Italy and Greece; and such is, at present, nearly all that happy portion of the earth's surface.

There are, however, certain intrinsic causes which appear to arrest the progress of particular races, even though situated amidst the most favourable circumstances.

VARIETIES OF THE HUMAN SPECIES.

Although the human species would appear to be single, since the union of any of its members produces individuals capable of propagation*, there are, nevertheless, certain hereditary peculiarities of conformation observable, which constitute what are termed *races*.

Three of these in particular appear eminently distinct: the *Caucasian*, or white, the *Mongolian*, or yellow, and the *Ethiopian*, or negro.

The Caucasian, to which we belong, is distinguished by the beauty of the oval which forms the

* It is now certain that this circumstance affords no proof of specifical identity, inasmuch as many nearly allied but obviously distinct species produce hybrids that are prolific *inter se*: an instance of which I have just witnessed, in the class of birds, of a brood of ducks, both parents of which were half mallard and half pintail (*Anas boschas* and *A. acuta*). See note to p. 7.—ED.

head: and it is this one which has given rise to the most civilized nations,—to those which have generally held the rest in subjection: it varies in complexion and in the colour of the hair.

The Mongolian is known by his projecting cheek-bones, flat visage, narrow and oblique eyebrows, scanty beard, and olive complexion. Great empires have been established by this race in China and Japan, and its conquests have sometimes extended to this side of the Great Desert; but its civilization has always remained stationary.

The Negro race is confined to the southward of the Atlas chain of mountains: its colour is black, its hair crisped, the cranium compressed, and nose flattened. The projecting muzzle and thick lips evidently approximate it to the Apes: the hordes of which it is composed have always continued barbarous.

The name *Caucasian* has been affixed to the race from which we descend, because tradition and the filiation of nations seem to refer its origin to that group of mountains situate between the Caspian and Black Seas, whence it has apparently extended by radiating all around. The nations of the Caucasus, or the Circassians and Georgians, are even now considered as the handsomest on earth. The principal ramifications of this race may be distinguished by the analogies of language. The Armenian or Syrian branch, spreading southward, produced the Assyrians, the Chaldeans, the hitherto untameable Arabs, who, after Mahomet, expected to become masters of the world; the Phœnicians, the Jews, the Abyssinians, which were Arabian colonies, and most probably the Egyptians. It is from this branch, always inclined to mysticism, that have sprung the most widely extended forms of religion. Science and literature have sometimes flourished among its nations, but always in a strange disguise and figurative style.

The Indian, German, and Pelasgic branch is much more extended, and was much earlier divided: notwithstanding which, the most numerous affinities have been recognized between its four principal languages—the Sanscrit, the present sacred language of the Hindoos, and the parent of the greater number of the dialects of Hindostan; the ancient language of the Pelasgi, common parent of the Greek, Latin, many tongues that are extinct, and of all those of the south of Europe; the Gothic or Teutonic, from which are derived the languages of the north and north-west of Europe, such as the German, Dutch, English, Danish, Swedish, and their dialects; and finally, the Sclavonian, from which are descended those of the north-east, the Russian, Polish, Bohemian, and that of the Vandals.

It is by this great and venerable branch of the Caucasian stock, that philosophy, the arts and sciences, have been carried to their present state of advancement; and it has continued to be the depository of them for thirty centuries.

It was preceded in Europe by the Celts, whose tribes, once very numerous, came by the north, and are now confined to its most western extremities; and by the Cantabrians, who passed from Africa into Spain, and have become confounded with the many nations whose posterity have intermingled in that peninsula.

The ancient Persians originate from the same source as the Indians, and their descendants still present a very close resemblance to the nations of Europe.

The Scythian and Tartar branch, extending first towards the north and north-east, and always wandering over the immense plains of those countries, returned but to devastate the happier abodes of their more civilized brethren. The Scythians, who, at so remote a period, made irruptions into Upper Asia; the Parthians, who there destroyed the Greek and Roman domination; the Turks, who there subverted that of the Arabs, and subjugated in Europe the unfortunate remnant of the Grecian people, were all offsets from this branch. The Finlanders and Hungarians are tribes of the same division, which have strayed among the Sclavonic and Teutonic nations. Their original country, to the north and eastward of the Caspian Sea, still contains inhabitants who have the same origin, and speak similar languages; but these are mingled with many other petty nations, variously descended, and of different languages. The Tartars remained unmixed longer than the others throughout that extent of country included between the mouth of the Danube to beyond the Irtisch, from which they so long menaced Russia, and where they have finally been subjugated by her. The Mongoles, however, have mingled their blood with that of the nations they conquered, many traces of which may still be found among the inhabitants of Lesser Tartary.

It is to the east of this Tartar branch of the Caucasian race that the Mongolian race begins, whence it extends to the eastern ocean. Its branches, the Calmucks and Kalkas, still wandering shepherds,

Near it, we conceive, should be placed the Addax, together with the *A. sylvatica, decula, scripta*, and one or two others. The *A. scripta*, or Harnessed Antelope, is an elegant small species, the *Guib* of Buffon, of a lively fulvous colour, marked with *harness*-like white stripes and spots. The *A. zebra* has dark regular stripes across the crupper.]

Fig. 62.—Prong-horned Antelope.

i. Horns bifurcated, (*Antilocapra*, Ord; *Dicranoceros*, Smith)

Of all the forms of hollow horns, this is the most singular: a compressed branch is given off from their base or trunk, almost like the antler of a Stag; the pointed tips curve backward. The best known species is

The *Cabril* of the Canadians (*A. furcifera*, H. Smith), which inhabits the extensive plains of the centre and west of North America in vast herds: its size is nearly that of the Roe; hair thick, waved, and reddish; the antler of its horns situate near the middle of their height. [Nearly allied is the *A. palmata*, Smith, decidedly a distinct species, which has palmated forked horns, that it employs in scooping away the snow: it is a mountain animal, the range of which appears to be more southward than that of the other.]

k. Four horns (*Tetraceros*, Leach).

This subdivision, recently discovered in India, was not unknown to the ancients. Ælian speaks of it, xv. c. 14, by the name of the *Four-horned Oryx* *: the anterior pair are before the eyes, the posterior completely behind the frontal. [As the position of the horns varies in some groups of two-horned Antelopes, it may be that the anterior pair of the four-horned species are represented in the greater number, and the posterior pair in the Bush Antelopes (*Philantomba*).]

The *Tchicarra* (*A. chicarra*, Hardw.).—Size of a Roe, and nearly uniform fulvous: no horns in the female sex. It is found in the forests of Hindostan. The *A. quadricornis*, Blainv., is only known to me by a cranium, the anterior horns of which are proportionally larger; perhaps it may only differ in age.

l. Two smooth horns.

The Nylghau (*A. picta*, and *trago-camelus*, Gm.).—As large as a Stag, and larger: horns short, and recurved forward, peculiar to the male sex; a beard under the middle of the neck. Inhabits India.

The Chamois (*A. rupricapra*, Lin.).—The only ruminant of western Europe that can be compared with the Antelopes, but presenting peculiar characters. Its smooth horns are curved abruptly backward like a hook: behind each ear, is a sac beneath the skin, which opens externally by a small orifice.† Its size is that of a large Goat. Hair deep brown, with a black band descending from the eye towards the middle. This species traverses rocks and precipices with extreme agility, inhabiting in small troops the middle region of the highest mountains. [The *A. thar, sumatrensis, ghorral*, and other goat-like species, seem to be allied to this group and to that of *A. strepsiceros*.]

Col. Smith separates from the Antelopes, under the generic title of

THE GNUS (*Catoblepas*),—

The *Antilope gnu*, Gm.; a very extraordinary species, which, at first sight, seems to be a monstrous being, compounded of parts of different animals. It has the body and crupper of a small Horse, covered with brown hair; the tail furnished with long white hairs, like that of a Horse; and on the neck a beautiful flowing mane, white at base, and black at the tip of the hairs. Its horns, approximated and enlarged at the base, like those of the Cape Buffalo, descend outwardly, and turn up at the point; the muzzle is large, flat, and surrounded by a circle of projecting hairs: under the throat and dewlap is another black mane; and the legs are as slender and light as those of a Stag. Both sexes have horns.

This animal inhabits the mountains northward of the Cape; where it does not appear common, although the ancients seem to have had some knowledge of it. [There are two other very distinct species, the Brindled Gnu (*C. gorgon*), and the Taurine Gnu (*C. taurina*), both also from the interior of South Africa.]

The three remaining genera have the bony core of the horns occupied, to a considerable extent, with cells, that communicate with the frontal sinuses. The direction of their horns characterizes the several divisions.

THE GOATS (*Capra*, Lin.)—

Have the horns directed upwards and backwards: their chin is generally furnished with a long beard, and the chanfrin almost always concave.

* The fossil cranium and some other bones of a gigantic four-horned ruminant, have lately been discovered in the productive Sivalik deposits of Northern India, the *Sivatherium*, Caut, and Falc, twice the size of a large Ox.—ED.

† It was perhaps a miscomprehension of the nature of this aperture which led the ancients to say, after Empedocles, that Goats breat' through their ears.

The Wild Goat, or *Ægagrus* (*C. ægagrus*, Gm.)—Appears to be the stock of all our domestic breeds, and is distinguished by its anteriorly sharp horns, very large in the male, short and sometimes wanting in the female; which is also sometimes the case with the different Ibexes. It inhabits the mountains of Persia in troops, where it is known by the appellation *pasing*, and perhaps those of several other countries, even the Alps. The *oriental bezoar* is a concretion found in its intestines.

Fig. 63.—Angora Goat.

Domestic Goats (*C. hircus*, Lin.), vary exceedingly in size, colour, and the length and texture of their coat; also in the magnitude, and even the number of their horns. Those of Angora and Cappadocia have the longest and most silky hair. The Thibet Goats are celebrated for the admirably fine wool which grows among their hair, of which the Cashmere stuffs are fabricated. There is a race in Upper Egypt with short hair, convex chanfrin, and projecting lower jaw, which probably is hybrid. The Goats of Guinea, termed *mambrines* and *juida*, are very small, with horns inclining backwards. All of them are robust, capricious, wandering animals, that betray their mountain origin by affecting dry and wild situations, where they feed on coarse herbage and the shoots of bushes. They do much injury in forests. The kid only is eaten, but their milk is useful in several diseases. The female can produce at seven months, and goes with young five months; she generally yeans two kids. The male engenders at a year old, and one suffices for more than a hundred females: in five or six years he becomes aged.

The Ibex (*C. ibex*, Lin.).—Immense horns, square in front, and marked with prominent transverse knots. It inhabits the most elevated summits of lofty mountain chains, throughout the whole ancient Continent. The Caucasian Ibex (*C. caucasica*), has great triangular horns, obtuse but not square in front, and notched as in the preceding. Both species propagate with the Domestic Goat. The African Maned Ibex (*C. æthiopica*) is another. [These various animals with enormous horns are said to precipitate themselves fearlessly down precipices, always falling on the horns, the elasticity of which secures them from injury. Those who have observed the force with which domestic Rams butt at each other, mutually striking the forehead, will feel less surprise at the Ibexes withstanding the shock of a fall.]

THE SHEEP (*Ovis*, Lin.)—

Have horns directed backward, and then inclining spirally more or less forward; their chanfrin is generally convex, and they have no beard. They so little merit to be generically separated from the Goats, that the two produce by intermixture a fertile offspring. As in the Goats, there are several wild races or species, closely allied together.

The Argali, or Wild Sheep of Siberia (*Ov. ammon*, Lin.),—the male of which has very large horns, triangular at base, the angles rounded, flattened in front, and transversely striated; those of the female are falchion-shaped and compressed. Its hair, in summer, is short and greyish-fulvous; in winter close, stiff, and reddish-grey, with some white or whitish upon the muzzle, throat, and under-parts. There is always, as in the Stag, a yellowish space around the tail, which latter is very short. This animal inhabits the mountains of all Asia, and attains the stature of a Fallow Deer. [A smaller and distinct species inhabits the Himmalaya mountains, which is termed the *Burrhal*: there are specimens in the Museums of the Linnæan and Zoological Societies, London.]

The Corsican Moufflon (*Ov. musimon*, Pal.)—appears to differ only in its inferior size, and in the deficiency or smallness of the horns in the female sex. It is said to be also found in Crete. There are some varieties wholly or partially black, and others more or less white.

It is probable that the American Moufflon (*Ov. montana*) is a species of Argali, which may have crossed the sea on the ice. Its horns are very stout, and more perfectly spiral than those of the Asiatic Argali.

The African Moufflon (*Ov. tragelephus*, Cuv.) has soft reddish hair, with a long mane hanging under the neck, and another at each ankle; the tail short: it appears to be a distinct species, and inhabits the rocky regions of Barbary; M. Geoffroy observed it in Egypt.

[illegible] Moufflon or Argali, it is believed that the innumerable breeds of our woolly domestic Sheep have been [illegible] which, the Dog alone excepted, have split into a greater number of varieties than any other. [illegible]ct, however, at variance with this supposition, and which we have never yet found to be [illegible]e wild races have exceedingly short tails, whereas the domestic breeds have generally, if [illegible]tilated, tails that reach nearly to the ground. It is easier to conceive the loss of this [illegible]estic breeds, than its acquirement or extension, and the latter theory is borne out

[illegible] Europe with fine or common wool; large and small; with big or little horns, wanting in the [illegible] sexes, &c. The most interesting varieties are the Spanish or *Merino*, which has a fine curly [illegible]ge spiral horns in the male, now beginning to be diffused through Europe, and the English, which [illegible]ne wool. The most common variety in southern Russia has a very long tail. Those of India and

traverse the great desert. Thrice did their ancestors, under Attila, Genghis, and Tamerlane, spread far the terror of their name. The Chinese are the most anciently civilized branch, not only of this race, but of all known nations. A third branch, the Mantchures, have recently conquered and still govern China. The Japanese, Coreans, and nearly all the hordes which extend to the north-east of Siberia, subject to Russia, are also to be considered, in a great measure, as originating from this race; and such also is deemed to be the fact with regard to the original inhabitants of various islands bordering on that archipelago. With the exception of some Chinese literati, the nations of the Mongolian race pertain generally to different sects of Buddhism, or the religion of Fo.

The origin of this great race appears to have been in the Altai mountains, as that of ours in the Caucasus; but it is impossible to trace with the same certainty the filiation of its different branches. The history of these wandering nations is as fugitive as their establishments; and that of the Chinese, confined exclusively to their own empire, furnishes little that is satisfactory with respect to their neighbours. The affinities of their languages are also too little known to direct us in this labyrinth.

The languages of the north of the peninsula beyond the Ganges, as well as that of Thibet, bear some relation to the Chinese, at least in their monosyllabic structure; and the people who speak them are not without resemblance to the other Mongoles: but the south of this peninsula is inhabited by Malays, whose forms approach them much nearer to the Indians, and whose race and language are distributed over the coasts of all the islands of the Indian archipelago. The innumerable small islands of the southern ocean are also peopled by a handsome race, who appear to hold a near relation to the Indians, and whose language has much affinity with the Malay: but in the interior of the larger islands, particularly in the milder portions of them, there exists another race of men with black complexions, and negro faces, all extremely barbarous, which are named Alfourous; and on the coasts of New Guinea and the neighbouring islands, are other Negroes nearly similar to those of the eastern coast of Africa, which are termed Papous; to the latter are generally referred the natives of Van Diemen's Land [now rapidly approaching to extermination], and those of New Holland to the Alfourous.*

Neither the Malays nor the Papous are easily referable to either of the three great races; but can the former be clearly distinguished from their neighbours on both sides, the Caucasian Indians and the Mongolian Chinese? We avow that we cannot discern in them sufficient traits for that purpose. Are the Papous Negroes, which may formerly have strayed into the Indian Ocean? We possess neither figures nor descriptions precise enough to enable us to reply to this question.

The inhabitants of the north of both continents, the Samoyedes, the Laplanders, and the Esquimaux, are derived, according to some, from the Mongolian race: but others regard them as mere degenerate offsets from the Scythian and Tartar branches of the Caucasian race.

The Americans have not yet been referred clearly to either of the races of the eastern continent; nevertheless, they have no precise or constant character, which can entitle them to be considered as a particular one. Their copper-coloured complexion is not sufficient: their general black hair and scanty beard would induce us to approximate them to the Mongoles, if their defined features, their nose as projecting as ours, their large and open eyes, did not oppose such a theory, and correspond with the features of the European. Their languages are as numberless as their tribes, and no demonstrative analogies have as yet been obtained, either with each other, or with those of the ancient world.†

[With all deference, I would suggest that naturalists are much too prone to confound resemblance with identity; as if any reason existed of necessity, for analogous races to differ in the least degree. How many geographical mutual representatives are there, which the analogy of allied races forcibly indicates to be distinct, though undistinguishable on minute comparison! How nearly also do many acknowledged species resemble! Bearing these facts in mind, does it not appear that the Americans have as good a claim to be regarded as a primary race, as the Mongolians have to be separated as such from the Caucasians? The arrangement of Blumenbach, who adds the Malayan and American races to the three admitted by Cuvier, has been more generally adopted: but there would seem to be quite as good reason for admitting others. Fischer, in his *Synopsis Mammalium*, indicates what he conceives to be seven species of *Homo* (reducing the number that had previously

* Refer, for the different races which people the islands of the Indian and Pacific Oceans, to the dissertation of MM. Lesson and Garnot, in the *Zoologie du Voyage de la Coquille*, p. 1—113. For the languages of the Asiatic nations, and their affinities, consult the *Asia Polyglotta* of M. Klaproth

† See, on the subject of the Americans, the travels of M. de Humboldt, so rich in important information, and the dissertations of Vater and of Mitchell.

been assigned by Bory St. Vincent): and the numerous divisions and subdivisions of that naturalist being tolerably in accordance with the apparent value of the characters presented, whether or not they truly represent the real distinctions, or, in some instances, similarity be confounded with identity (a problem to which philology seems to offer the only key), the outline of his arrangement may be transferred to the present work, where it may chance to prove useful to some observers. His supposed *species* are as follow:—

1. *H. Japeticus*, Bory; corresponding to the Caucasian race of Cuvier.—This is distributed under three principal varieties, termed *Caucasicus*, *Arabicus*, and *Indicus*: of these the first is arranged into five subvarieties, named *Caucasicus* (*Orientalis*), *Pelagius* (*Meridionalis*), *Celticus* (*Occidentalis*), *Germanicus* (*Borealis*), and *Sclavonicus* (*Intermedius*), which severally comprehend the Caucasic, Pelasgic, Celtic, Teutonic, and Sclavonic (including the Sarmatic) nations; the second into two subvarieties, *Atlanticus* (*Occidentalis*), and *Adamicus* (*Orientalis*), respectively containing the Phœnicians, ancient Numidians, and Guanches, or the Punic nations, and the Abyssinians, primitive Egyptians (modern Copts), Jews, Armenians, Arabians, &c., or the Coptic and Semitic nations.

2. *H. Neptunianus*, Bory.—Ranged under three subdivisions: the first unnamed (Qu. *Malayanus?*) allied to — probably much mingled with — the Indian variety of *H. Japeticus*, and consisting of the well-known Malays, which people the coasts only of the peninsula of Malacca, the islands of the Indian ocean, Madagascar, &c., never penetrating inland; the second, *Occidentalis*, comprising the New Zealanders, and natives of the Society, Friendly, Sandwich, and other islands scattered over the Pacific ocean,—it is suggested, also, (but with due and much required hesitation,) the ancient Mexicans and Peruvians: the third, *Papuensis*, composed of certain inhabitants of part of the north coast of New Guinea, the shores of the islands Waigou, Salwaty, Gammeu, and a few others, is obviously a hybrid race, derived from the intermixture of the Malay and true Papou. Cuvier has remarked the affinity of language subsisting between the Malays and South Sea Islanders.

3. *H. Scythicus*, Bory.—The first division of this, unnamed (Qu. *Mongolensis?*) consists of the Calmucks and other Tartars; the second, *Sinicus* (*Homo sinicus* of Bory), of the Chinese, Japanese, &c.; and the third and last, *Hyperboreus* (*Homo hyperboreus*, Bory), of the Esquimaux. It corresponds to the Mongolian race of Cuvier.

4. *H. Americanus*, Bory.—"*Species*," the author writes, "*adhuc male cognita, forsan tota vel ex parte ad Scythicam reducenda*," of which the latter only is in the least probable. "*Autochthones Americæ meridionalis, in stirpes innumeras distributi; e. g. Omaguæ, Guarani, Coroadi, Atures, Otomaqui, Botucudi, Guiacæ, Cherrucæ*, &c." * A second division is designated *Patagonus*, (being the *Homo Patagonus* of Bory,) composed of the large-statured Patagonians.

5. *H. Columbicus*, Bory.—The ordinary *red Indian* of America.

6. *H. Æthiopicus*, Bory.—Divided into the true Negro, not otherwise named; *Caffer*, (*Homo Caffer*, Bory,) inhabiting Caffraria, and part of the coast of Madagascar; *Melanoides*, (*Homo melaninus*, Bory), the Papous or indigenous inhabitants of Madagascar, the shores of New Guinea, the islands of New Britain, New Ireland, and many others, also of Van Diemen's Land; and *Hottentotus* (*Homo Hottentotus*, Bory), the Bush and other Hottentots, which, it may be remarked, have not a few analogies with the nomadic Mongoles. The last appear to have been much reduced and encroached on, till a remnant only is left near the south coast of Africa, just as the Celts are now confined to the exteme west of Europe.

7. Lastly, *H. Polynesius*, Fischer (*H. australaricus*, Bory).—The Alfourous, the lowest in the scale of human beings: comprising the inland inhabitants of the Malay peninsula, the islands of the Indian Ocean, Madagascar, New Guinea, New Holland, &c.

Such is the arrangement of an able and accomplished naturalist, published in 1829, or the same year in which our author gave to the world his second and last edition of the present work. The most recent authority, which is the third edition of Dr. Prichard's elaborate "Researches into the Physical History of Mankind," contends strenuously for unity of species in the genus *Homo*: but it may be remarked that much stress is laid on the productiveness of mingled races of mankind, without any new or satisfactory evidence being adduced in proof of the comparative sterility of the hybrid offspring of the more intimately approximate races which have claim to be ranked as species; such as

* "A species imperfectly known, probably or in part referable to the preceding one. It comprehends numerous tribes of South America," some of which are above named. For the characters of these *species*, want of space compels me to refer the reader to the original work. A cranium of the savage tribe of *Botucudi* is figured by Spix in his work on American *Quadrumana*.

the wild bovine and striped equine animals, &c. &c. The following are the leading *varieties* of Man, according to the opinion and arguments of Dr. Prichard.

"On comparing the principal varieties of form and structure which distinguish the inhabitants of different countries, we find that there are seven classes of nations which may be separated from each other by strongly marked lines. Among their principal characteristics are peculiar forms of the skull, but these are by no means the only difference which require notice and particular description. These seven principal classes are, first, those nations which in the form of their skulls and other physical characters resemble Europeans, including many nations in Asia and some in Africa; secondly, races nearly similar in figure, and in the shape of the head, to the Kalmucks, Mongoles, and Chinese. These two first classes of nations will be designated, for reasons to be explained, Iranian and Turanian nations, in preference to Caucasian and Mongolian. * * * The third class are the native American nations, excluding the Esquimaux and some tribes which resemble them more than the majority of inhabitants of the New World. The fourth class comprises only the Hottentot and Bushman race. A fifth class are the Negroes; the sixth, the Papuas, or woolly-haired nations of Polynesia; the seventh, the Alfourou and Australian races. The nations comprised under these departments of mankind differ so strikingly from each other, that it would be improper to include any two of them in one section, and there is no other division of the human family that is by physical traits so strongly characterized. There are, indeed, some nations that cannot be considered as falling entirely within either of these divisions, but they may be looked upon as approximating to one or another of them."*

The same writer affirms, of the Caucasian race of Cuvier, that "there is no truth in the assertion that the traditions of all these nations deduce their origin from Caucasus†," and states, of his Indo-Atlantic, or *Iranian* nations, that "complexion does not enter among the characters of this type, since it is of all shades, from the white and florid colour of the northern Europeans, to the jet-black of many tribes in Lybia, and southward of Mount Atlas. In many races, as we shall hereafter prove, the type has degenerated. The ancient Celts appear, for example, to have had by no means the same developement of the head as the Greeks, and the Indians display some differences in the configuration of the skull," &c.‡

It appears to be conclusively proved that barbarism and insufficient nourishment tend, in a few generations, to deteriorate the physical characters of even the highest races of mankind, by increasing the facial angle, &c.§; while the reverse induces proportional improvement. Still there is reason to suspect that the diversities which are thus occasioned are restrained within moderate limits; and this remarkable fact must be borne in mind (which I believe has not been hitherto stated), that while an artificial mode of life would seem to have produced those acknowledged *varieties* of species which are noticeable among such of the lower animals as have been domesticated, we observe very dissimilar races of human beings among those whose mannner of living is least artificial of any, and which, furthermore, in numerous instances, inhabit the same countries, besides being widely diffused; thus proving that climate and locality exert less influence than has been imagined. This most difficult subject of inquiry, in fine, is endlessly perplexed, and in several instances rendered quite inextricable, by the occasional blending of two or more diverse races, in every degree of proportion. There are also decisive proofs (afforded by architectural reliques scattered over Siberia and both Americas) of great nations having been utterly exterminated, whose very names have perished: and if civilized, or comparatively civilized, populous nations have thus become so completely sunk in oblivion, that we infer their former existence only as that of some lost tribes of animals can be recalled, how very many hordes of savages, who erect no memorials, may have been extirpated, and are forgotten irretrievably. Hence the extreme and apparently insuperable difficulties which, it is probable, will continue to oppose the definitive solution of the intricate and peculiarly interesting problem which we have been considering.]

* Vol. i. 246-7 † Id. 259. ‡ 1. 262 § Vide id. vol. ii. 349

THE SECOND ORDER OF MAMMALIANS.

QUADRUMANA.

Independently of the anatomical details which distinguish it from Man, and which we have indicated, this family differs from our species in a very obvious character, having the thumbs of the hind feet free and opposable to the other digits, which are as long and flexible as those of the hand: in consequence of this, all the species climb trees with facility, while it is only with pain and difficulty that they can stand and walk upright, their foot then resting on its outer edge only, and their narrow pelvis being unfavourable to an equilibrium. They all have intestines very similar to those of Man*, the eyes directed forward, the mammæ on the breast, the penis pendent, the brain with three lobes on each side, the posterior of which covers the cerebellum, and the temporal fossæ separated from the orbit by a bony partition. In every thing else, however, they gradually recede from him, in presenting a muzzle more and more elongated, a tail and a gait more like that of quadrupeds: nevertheless, the freedom of their arms, and the complication of their hands, admit of their performing many of the actions of Man, as well as to imitate his gestures.

They have long been divided into two genera, the Monkeys and the Lemurs, which, by the multiplication of secondary forms, have now become two small families, between which must be placed a third genus, that of the Ouistitis [or Marmosets], which cannot be referred to either of the others.

THE MONKEY-LIKE ANIMALS (*Simia*, Linnæus).

These are all Quadrumana, which have four straight incisors to each jaw, and flat nails to all the extremities,—two characters which approximate them more nearly to Man than the subsequent genera. Their molars have also blunt tubercles like ours, and they subsist mainly upon fruits; but their canines, being longer than the other teeth, supply them with a weapon which we do not possess, and require a vacant space in the opposite jaw to receive them when the mouth is closed.

They may be divided, according to the number of their molars, into two principal sub-genera, which again subdivide into numerous others.

The MONKEYS (*Singes*), properly so called, or those of the ancient continent,

[CATARRHINI, *Geof.*],—

Have the same number of grinders as Man, but otherwise differ among themselves in the characters which give rise to the following subdivisions.

THE OURANGS (*Simia*, Erxl., *Pithecus*, Geof.),—

Are the only Apes of the ancient continent which have no callosities on the buttocks; their hyoid bone, liver, and cœcum resemble those of Man. Their nose does not project; they have no cheek pouches, nor any vestige of a tail.

Some of them have arms long enough to reach the ground when standing; their legs, on the contrary, are very short. Such are the Ourangs, strictly so called.

* Here we must except the genus *Semnopithecus*, and probably also *Colobus*.—ED.

THE OURANG-OUTANG* (*Simia satyrus*, Lin.)

Of all animals, this is reputed to bear the nearest resemblance to Man in the form of its head, the magnitude of its forehead, and volume of brain; but the exaggerated descriptions of some authors respecting this similarity arise partly from the circumstance of only young individuals having been observed, as there is every reason to believe that, with age, the muzzle becomes much more prominent [a fact now ascertained]. The body is covered with coarse red hair, the face is bluish, and the hinder thumbs very short compared with the toes. The lips are capable of a singular elongation†, and possess great mobility. Its history has been much confounded with that of the other large Apes, and especially of the Chimpanzee; but, after subjecting it to a rigorous analysis, I have ascertained that it inhabits only the most eastern countries, such as Malacca, Cochin China, and particularly the great island of Borneo, whence it has been sometimes brought by the route of Java, though very rarely. When young, and such as it has been seen in Europe, it is a very mild animal, that is easily rendered tame and attached, and which, by its conformation, is enabled to imitate many of our actions; but its intelligence appears to be lower than has been asserted, not very much surpassing that of the Dog. Camper discovered, and has well described, two membranous sacs which communicate with the glottis of this animal, and obstruct its voice; but he is mistaken in supposing that the nails are always absent from the hinder thumbs.

There is an ape in Borneo, at present only known by its skeleton, called the *Pongo*, which so closely resembles the Ourang-outang in all its parts, and by the arrangement of the cavities and sutures of its head, that notwithstanding the great prominence of its muzzle, the smallness of the cranium, and the height of the branches of the lower jaw, we are inclined to consider as an adult, if not of this species of Ourang, at least of another very nearly allied to it. The length of its arms, and of the apophyses of its cervical vertebræ, together with the tuberosity of its calcaneum, may enable it to assume the vertical position. It is the largest of known Apes, approaching to the size of Man.

[The Pongo has proved to be a second species of Ourang, covered with black, relieved with dark red hair, and which at present is known only to occur in Borneo, where the Red Ourang has not been ascertained to exist. Both attain the same large dimensions, and are distinguished as the *Pithecus Wormbii* and *P. Abelii*. They differ somewhat in the configuration of the cranium, and considerably in the profile of the face, as seen in the skull. A third species, also from Borneo, has more recently been determined by Prof. Owen, of which only a single adult skull has been received; it announces a smaller animal, which has been named *P. morio*. The adult males of this genus have an immense projecting tuberosity on each cheek.‡

These Ourangs do not ordinarily assume the upright attitude, to maintain which they are obliged to raise, and throw their long arms backward, in order to preserve a balance; the outer edges only of their feet are applied to the ground, where they commonly progress by resting on the knuckles, and swinging the body forward between the arms. Their structure is more designed for traversing the forest boughs; and they are said to inhabit the upland forests of the interior of their native countries. The old males are reported to be savage and solitary, and much dreaded by the Alfourou inhabitants of their native region; each appropriating a particular district, into which it resents intrusion. There is reason to suspect that they are not exclusively vegetable feeders, but subsist in part on the eggs and callow young of birds. They are sedentary and inactive animals, possessed of great strength.

So excessive is the degradation of the adult from the characters which it exhibits in youth, that our author, in his first edition, arranged the Pongo next to the Baboons, allowing them the precedence. According to M. Geoffroy, "the brain of the young Ourang bears a very close resemblance to that of a child; and the skull, also, might be taken, at an early age, for that of the latter, were it not for the developement of the bones of the face. But it happens, in consequence of its advance in age, that the brain ceases to enlarge, while its case continually increases. The latter becomes thickened, but in an unequal degree; enormous bony ridges appear, and the animal assumes a frightful aspect. When we compare the effects of age in Man and the Ourang, the difference is seen to be, that in the latter there is a super-developement of the osseous, muscular, and tegumentary systems, more towards the upper part than the lower, while the developement of the brain is entirely arrested." It is only in the male sex, however, that the cranial ridges appear, the canines, also, of the females being much smaller. M. Geoffroy thus describes the skull of the Pongo, before its identity as an Ourang had been ascertained:— "What is most remarkable," he observes, "is the excessive elongation of the muzzle; and as this considerable volume of the muzzle cannot be gained but at the expence of the other adjoining parts, we accordingly find that there is scarcely any apparent forehead, that the bony box which contains the brain is uncommonly small, and that the occipital foramen is situated as far as the posterior part of the head. The immense muzzle, moreover, is remarkable, not only for the enormous thickness of the gums, but also for the extraordinary size of the canine and incisor teeth with which they are provided; the incisors exceed in magnitude those of a Lion, and the canines do not differ much in dimensions from those of the same animal: the occiput also is elevated at its point, and forms a quadrilateral protuberance, very large and where three bony crests are produced, not less apparent nor less solid than those of the Lion. Two of

* ... is a Malay word, signifying *rational being*, which is ...an, the Ourang-outang, and the Elephant. *Outang* ... *of the woods*: hence *Ourang-outang*.

† ... a certain extent, in the Hottentot race of man-

‡ ... (1838) a young male and female of the Bl... Ourang (*P. Wormbii*), in the menagerie of the Zoological Society, which have continued now for several months in a very thriving condition, and afford reasonable grounds for expectation that they will live to attain maturity. Most of those previously imported have been ...l sickly.—ED.

these crests are considerably elevated, and extend laterally to the auricular foramina. Another extends across the vertex, and then assumes a bifurcal form, as in the Lion, above the forehead in two lateral branches, which proceed as far as the external side of the upper edge of the orbits. These little crests are decisively marked, and form an equilateral triangle with the upper edge of the orbital foramina. The head is formed like the half of a pyramid, and the auricular foramina are placed so considerably above the palatine bones, that a line let down from the former to the internal edge of the *ossa palatina*, would form, with a horizontal line, an angle of twenty-five degrees." It varies to about thirty degrees.

All the above modifications have immediate reference to the immense size of the canines, which necessitates a proportional developement of the jaws, and the high cranial ridges to furnish attachment to muscles of sufficient power to work them. The Ourangs do not cut their huge permanent teeth until nearly full grown.*]

In the other Ourangs, the arms descend only to the knees. They have no forehead, and their cranium retreats immediately from the crest of the eyebrow. The name of CHIMPANZEE might be exclusively applied to them.

Sim. troglodytes, Lin. [*Troglodytes niger* of others].—Covered with black or brown hair, scanty in front; [a white marking on the rump]. If the reports of travellers can be relied on, this animal must equal or be superior in size to Man. [The skeleton of an adult female in London is considerably smaller.] It inhabits Guinea and Congo, lives in troops, constructs huts of branches, arms itself with clubs and stones, and thus repulses Man and Elephants; pursues and abducts, it is said, negro women†, &c. Naturalists have generally confounded it with the Ourang-outang. In domestication it is very docile, and readily learns to walk, sit, and eat like a man. [It is much more a ground animal than the Ourangs, and runs on its lower extremities without difficulty, holding up the arms. Is of a lively and active disposition. The facial angle of the adult about thirty-five degrees. By the general consent of living naturalists, the Chimpanzee is placed next to Man in the system, preceding the Ourangs, which it exceeds in general approximation to the human form.]

From the foregoing groups are now separated

THE GIBBONS (*Hylobates*, Illiger),—

Which, together with the long arms of the Ourangs, and the receding forehead of the Chimpanzee, possess [all of them] callosities on the buttocks like the true Monkeys; differing, however, from the latter in having no tail or cheek-pouches. All of them inhabit the most eastern part of India, and its archipelago.

The Onko Gibbon (*Sim. lar*, Lin.)—[This name is now by general consent applied to the next species, the present one being distinguished as *H. Rafflesii*, Geof.] Black, with white hairs round the face.

[The Lar Gibbon of Linnæus (*H. lar*, Geof.)—Black, with white hands and feet, and a white circle round the face. Is identical with *H. albimanus*, Vig. and Horsf., and probably with *H. variegatus*, Kuhl, which seems to differ only in colour, being brown where the other is black.

The Hoolock Gibbon (*H. hoolock*, Harlan).—Black, marked with white across the forehead.

The Coromandel Gibbon (*H. choromandus*, Ogilby).—Of a dingy pale brown, with black hair and whiskers.]

The Wou-wou Gibbon (*S. agilis*, Lin.)—Brown, the circle round the face and lower part of the back, pale fulvous [with also some white around the visage]. The young are of a uniform yellowish white. Its agility is extreme; it lives in pairs, and its name *Wou-wou* is derived from its cry.

The Gray Gibbon (*S. leucisca*, Schreb.)—Gray, with dark crown, and white beard and whiskers; the visage black. It lives among the reeds, and climbs up the highest stems of the bamboos, where it balances itself by its long arms.

We might separate from the other Gibbons

The Siamang (*S. syndactyla*, Raffles), which has the second and third toes of the hind foot united by a narrow membrane, the whole length of the first phalanx [a character which now and then occurs in some of the others, but in the present species is constant]. It is wholly black, with the chin and eyebrows rufous [and the throat bare]; lives in numerous troops, which are conducted by vigilant and courageous chiefs, which, at sunrise and sunset, make the forest resound with frightful cries. Its larynx has a membranous sac connected with it.

[All the above are mild and gentle animals in domestication, of extremely delicate constitutions when brought to our climate].

The remaining Monkey-like animals of the ancient continent have the liver divided into several

* It may be remarked generally, that, with the possession of formidable canines, *Quadrumana* acquire a consciousness of their efficacy as weapons, which renders them impatient of that controul, more particularly if based on fear, to which they had previously been submissive. Chastisement then excites their ire rather than affrights them; and if they cannot gratify their rage, they will pine and die. They require, in short, different treatment. An adult male Mandrill, which was long exhibited in London, would perform various feats indicative of intelligence, if *bribed* to do so by the offer of its favourite beverage. The notion that the species with prominent muzzles are therefore less intelligent, requires modification. The developement of brain, in all the *Simiæ*, as compared with that of Man, is arrested at a particular stage of advancement; but it does not follow that the growth of the other parts—that is, the developement of the other systems—should cease simultaneously: on the contrary, this proceeds to a variable extent in different species, and the projection of the muzzle, with its accompaniments, appears to increase in proportion to the stature ultimately attained; so that the adults of the smaller species are, in this respect, analogous to partially developed specimens of the larger, which correspond in disposition until they acquire the strength and armature of which an instinctive knowledge prompts them to resent affronts, and renders them so highly dangerous to tamper with. The Baboons are even remarkable for penetration and quickness of apprehension, however short their temper.—ED.

† Very highly improbable.—ED.

lobes; the cœcum thick, short, [except in *Semnopithecus*, and perhaps *Colobus*], and without any appendage: the hyoid bone has the form of a shield.

THE MONKEYS* (*Cercopithecus*, Erxl. in part), [*Guenons* of the French],—

Have a moderately prominent muzzle (of sixty degrees); cheek pouches; tail; callosities on the buttocks; the last of the inferior molars with four tubercles like the rest. Very numerous species of them, of various size and colouring, abound in Africa, living in troops, which do much damage to the gardens and cultivated fields. They are easily tamed, [and are lively and active animals. Their hair, unlike that of the preceding groups, is of two kinds, the outer commonly annulated above with two colours, producing a grizzled appearance, which in several imparts a tinge of green.

More than twenty species have been ascertained, and doubtless many others remain to be discovered. They vary in the proportional length of the fingers. The larger of them acquire, with their growth, a more projecting muzzle, and are the *Cercocebi* of some naturalists (a term now falling into disuse): these, in a few instances, manifest an additional relationship to the Baboons, in exhibiting bright colours on the genitals; as exemplified by the Malbrouck Monkey (*C. cynosurus*), in which the scrotum is vivid ultramarine, and the Vervet (*C. pygerythrus*), which has the same part green. Many are prettily variegated, as the Diana Monkey (*C. Diana*), which has a crescent-shaped white mark on the forehead, and a slender, pointed, white beard; the Mona Monkey (*C. mona*), &c. One only is of a red colour, the Patas (*C. rubra*). A few of the more recently discovered of them may be briefly indicated.

Campbell's Monkey (*C. Campbellii*, Waterhouse.)—Hair long, and parted on the back, of a grizzled black and yellow colour, nearly uniform blackish grey on the hind parts; beneath, dingy white; a black line encircling the fore part and sides of the crown of the head. From Sierra Leone.

The Bearded Monkey (*C. pogonias*, Ben.)—Hair very long; greyish, *i.e.*, grizzled black and yellowish white; a spot on each side of the head, another on the crown, and tip of the tail, black; cheeks furnished with an immense tuft of pale hair.

Red-eared Monkey (*C. erythrotis*, Waterh.)—Grey; the tail red, with a dark line along its upper surface; ears with very long red hairs internally; throat white; under parts of the body greyish. From Fernando Po.

Next follows a group of smaller species, of mild and confiding disposition; consisting of the Talapoin M. (*C. tal*[illegible] Geof., *Sim. melarrhina*, F. Cuv.), the Moustache M. (*S. cephus*, Lin.), the Vaulting M. (*S. petaurista*, Gm.), the Hocheur (*S. nictitans*, Gm.), &c. A new Monkey appertaining to it is the

C. Martini, Waterh.—Of a dark grey, the hairs annulated with yellowish white; lower portions of limbs, crown of the head, and tail, blackish; hairs near the root of the tail beneath, brown. Inhabits Fernando Po. Several of these smaller kinds are very common in Guinea. Allied to them are the larger green Monkeys; and the series terminates with the Mangabeys, or dusky-coloured white-eyelid Monkeys (*C. æthiops*, and *C. fuliginosus*), which display some peculiarities of gait and gesture, and have the most prominent muzzles of any.

The following occurs as a note in the original work. "Pennant has described certain *Guenons*"—*Doucs* rather—"without thumbs†, *Sim. polycomos* and *S. ferruginea*, of which Illiger has formed his genus COLOBUS, but I have not been able to see them, and for this reason have not introduced them. M. Temminck assures us that the head and teeth resemble those of a *Semnopithecus*." This group is now well established, and several species have been added to it; all of them, however, peculiar to Africa, as the members of the last-named genus are to Asia: they differ chiefly from the Doucs in possessing cheek-pouches, having the limbs similarly elongated, and only one sort of hair, as in the Apes. A small rudiment of a thumb exists in some of them.

Nine clearly distinct species have been ascertained; and there are probably many others. They resolve into two minor groups; the species composing the first are rather large animals, of a black ground-colour, with very long hair; those of the second division are smaller, with shorter hair, and rufous ground-colour. Their markings readily distinguish them.

The Black Colobin (*C. satanas*, Waterh.)—Quite black, with very long shaggy hair, obviously designed to protect it from the scorching rays of a vertical sun. This animal is common in Fernando Po, and when captured refuses to take sustenance, pining and moaning constantly and very piteously.

Ursine Colobin (*C. ursinus*, Ogilby.)—Black, with grey head and white tail. From Sierra Leone.

White-thighed Colobin? (*C.? leucomeros*, Ogilby.)—Established on some imperfect skins. The thighs white; head, legs, and tail undetermined. From the Gambia.

Sim. polycomos, Pennant; termed by him the "Full-bottomed Monkey."—Has a long yellowish-white sort of mane, compared to a full-bottomed wig, and a white tail. Brought from Sierra Leone.

C. guereza, Ruppel.—The throat and around the face white; and long flowing white hair on the shoulders and along each side of the body, as if a garment were thrown over it; end of the tail also white, and largely tufted. From Abyssinia.

C. rufoniger, Ogilby.—Black above, deep red beneath; locality unknown.

* The word *Monkey* is a diminutive of *Man*.—ED.

† The thumb is very small in the Doucs.—ED.

Sim. ferruginea, Pennant; called by him the "Bay Monkey."—Of a deep bay colour above; cheeks and under-parts very bright bay. From Sierra Leone.

C. Pennantii, Waterh.—Above blackish; beneath dingy yellow; the sides yellowish red, and cheeks white. From Fernando Po.

C. Temminckii, Kuhl.—Blackish above; rusty-red beneath and on the cheeks; the sides yellow. From the Gambia. Is identical with *C. obscurus*, Ogilby.

The skins of these animals are an article of traffic in Western Africa, but are commonly deprived of the head, limbs, and tail. Many *Cercopitheci* are prepared in the same manner.*]

THE DOUCS (*Semnopithecus*, F. Cuv.)—

Differ from the true Monkeys by having an additional small tubercle on the last of the inferior molars. They are the ordinary *Monkeys* of the East; and their lengthened limbs and extremely elongated tail [as in *Colobus*] give them a peculiar air. Their muzzle projects very little more than that of the Gibbons, and, like them, they have callosities on the buttocks; they appear, likewise, to have no cheek-pouches: their larynx is furnished with a sac. [The stomach (fig. 3) is singularly complicated, consisting of three divisions; first, a cardiac pouch, with smooth and simple parietes, slightly bifid at the extremity; secondly, a middle, very wide and sacculated portion; thirdly, a narrow, elongated canal, sacculated at its commencement, and of simple structure towards its termination: their food, accordingly, is supposed to be more herbaceous than that of other *Catarrhini*, which is further intimated by the blunter tubercles of their molars, and the elongation of their intestines and cœcum. Their hair is of one kind only, approaching in character to that of the Gibbons. Their movements are staid and deliberate, though capable of much agility; and the gravity of their deportment is expressed by their systematic name.

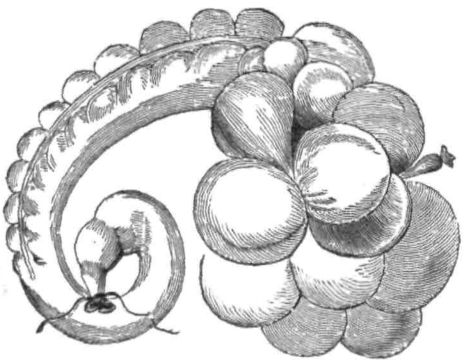

Fig. 3.

Fourteen or fifteen species have been determined, of which the most extraordinary is]

The Long-nosed or Proboscis Douc (*Sim. nasica*, Schr.; *Nasalis larvatus*, Geof.†) [The *S. recurvus*, Vig. and Horsf., is apparently the young.]—It is of large size, and yellowish colour tinted with red; the nose extremely long and projecting, in form of a sloping spatula. This species inhabits Borneo, and lives in great troops, which assemble morning and evening on the branches of the great trees on the banks of the rivers; its cry is *Kahau*. Is stated also to occur in Cochin China.

The Variegated Douc (*S. nemæus*, Geof.)—Remarkable for its lively and varied colouring: the body and arms are grey; the hands, thighs, and feet black; legs of a lively red; the tail, [fore-arm,] and a large triangular spot upon the loins, white; face orange; and there is also a black and red collar, and tufts of yellow hairs on the sides of the head. It inhabits Cochin China. (The genus *Lasiopyga* of Illiger was founded on a mutilated skin of this animal.)

S. entellus, Dufres. [The species most frequently brought alive to Europe.]—Of a light yellowish grey colour, with black hair on the eyebrows and sides of the head, directed forwards. From Upper Bengal, where it is held in superstitious reverence. [Some frequent the Pagodas.

Several are black, dusky, or ash-coloured. *S. auratus*, Geof., is uniform bright golden yellow, with a black patch on each knee. The Simpai (*S. melalophus*, Cuv.) is of a very lively red; beneath white: its face is blue; and a crest of black hairs reaches from one ear to the other. Some have the hair of the head turned up, forming a sort of crest. All are from the islands of the Indian Ocean, and neighbouring regions of Asia.]

THE MACAQUES (*Macacus*, Desm.)—

Possess, like the Doucs, a fifth tubercle on their last molars, and callosities and cheek-pouches like the true Monkeys. Their limbs are shorter and stouter than in the former; their muzzle is more elongated, and the superciliary ridge more prominent than in either the one or the other. Though docile when young, they become unmanageable with age. They have all a sac which communicates with

* I have availed myself of this opportunity to give a more complete list of the *Colobi* than has hitherto been published.—ED.

† The anatomy of this animal is now known to accord with that of the other Doucs.—ED.

the larynx under the thyroid cartilage, and which fills with air when they cry out. Their tail is pendent, and takes no part in their movements ; [it varies in length from a tubercle to longer than the body.] They produce early, but are not completely adult for four or five years. The period of gestation is seven months ; during the rutting season the external generative organs of the female become excessively distended [as in the Baboons]. Most of them [all] inhabit India [and its Archipelago.

At least seven species have been ascertained, the most remarkable of which is]

The Maned Macaque or Wanderoo (*Sim. Silenus* and *leonina*, Lin.)—Black, with an ash-coloured mane and whitish beard surrounding the head. [Tail moderately long, and slightly tufted.] Inhabits Ceylon.

[The Bonneted Macaque (*M. sinicus*), and the Toque (*M. radiatus*), have the hairs on the top of the head disposed as radii; these, with the Hare-lipped M. (*M. cynomolgus*), have long tails. In the Pig-tailed Macaque (*M. rhesus*), this appendage reaches little below the hamstrings : it is shorter, thin, and wrinkled in the Brown Macaque (*M. nemestrinus*); and in the Black M. (*M. niger*, Ben.; *Cynocephalus niger*, Desm., and of Cuvier's last edition), it is reduced to a mere tubercle. The Black Macaque is wholly of that colour, with an erect tuft of hair on the top of its head ; its native country Celebes.]

THE MAGOTS (*Inuus*, Cuv.)

Mere Macaques, which have a small tubercle in place of a tail. [According to this definition, the last-named species should be introduced here : the only known Magot, however, does not well range with the others ; its cranium is intermediate to those of the *Macaci* and *Cynocephali*].

The Barbary Magot (*Sim. sylvanus, pithecus*, and *inuus*, Lin.)—Completely covered with greenish-brown hair. Of all the tribe, this suffers least in our climates. Originally from Barbary, it is said to have become naturalized on the Rock of Gibraltar.* [This well-known species, in its wild state, is both lively and remarkably intelligent at all ages ; but, subjected to the restraint of captivity, becomes sullen and unmanageable as it grows up ; forcibly illustrating what has been stated in a note to the Ourangs.]

THE BABOONS (*Cynocephalus*, Cuv.),—

Together with the teeth, cheek-pouches, and callosities of the preceding, have an elongated muzzle abruptly truncate at the end, where the nostrils are pierced, which gives it a greater resemblance to that of a Dog than of other Monkeys ; their tail varies in length. They are generally large, ferocious, and dangerous animals, of which the majority [all of them] inhabit Africa.

[Some have the tail long and tufted, as the Gelada Baboon (*Macacus gelada* of Ruppell).—This has the upper parts covered with very long hair, of a pale brown on the head, shoulders, and rump, blackish on the back; a dark medial line extends backwards from the forehead ; the extremities are black. A native of Abyssinia.

The others have the hair grizzled or annulated. Such are the Tartarin Baboon (*Sim. hamadryas*, Lin.), of a slightly bluish ash-colour (grizzled black and white) ; face flesh-coloured : inhabits Arabia and Ethiopia. The Chacma B. (*Sim. porcaria*, Bodd. ; *S. ursina*, Penn ; *S. sphyngiola*, Herm.), which is black, with a yellowish or greenish glaze, particularly on the forehead ; the face and hands black, and the adult has a large mane. From the Cape of Good Hope. The Anubis B. (*C. anubis*, F. Cuv.), is another huge Cape species, uniformly grizzled black and yellow ; the face black, and snout much elongated. The Sphynx B. (*Sim. sphynx*, Lin., and it would appear from descriptions, also, *C. papio*, Desm.), is likewise yellowish, more or less tinged with brown ; face black ; the cheek-tufts fulvous : inhabits Guinea. Lastly, the Babouin (*Sim. cynocephalus*, F. Cuv.), has a shorter tail, and coat more inclining to greenish ; also whitish cheek-tufts, and flesh-coloured visage.]

THE MANDRILLS—

Are, of all the Monkey tribe, those which have the longest muzzle (thirty degrees †) ; their tail is very short ; they are also extremely brutal and ferocious ; nose as in the others.

The Mandrill Baboon (*Sim. maimon* and *mormon*, Lin.)—Greyish brown, inclining to olive above ; a small citron-yellow beard on the chin ; cheeks blue and furrowed. The adult males have the nose red, particularly at the end, where it is scarlet ; the genital parts and those about the anus, are of the same colour ; the buttocks are of a fine violet. It is difficult to imagine a more hideous and extraordinary animal. It nearly attains the size of a Man, and is a terror to the negroes of Guinea. Many details of its history have been mixed up with that of the Chimpanzee, and consequently with that of the Ourang-outang.

The Drill (*Sim. leucophæa*, F. Cuv.)—Yellowish grey, the visage black ; in old ones the coat becomes darker ; [the white hairs on the belly are much elongated], and the chin is bright red.

[Hideous as the animals of this genus appear, and disgustingly deformed to those who have only seen them in captivity, their adaptation to a peculiar mode of life is of course as exquisite as that of any other animal, and requires only to be understood to command an amount of admiration, which must lessen to a considerable

* *Pithecus* is the Greek name for Monkeys in general ; and the one of which the anatomy is given by Galen was a Magot, although Camper thought it was an Ourang-outang. M. de Blainville perceived this mistake, and I have proved it by comparing with these two species, all that Galen has stated respecting the anatomy of his *Pithecus*.

† The Ourangs will bear comparison.—ED.

extent the abhorrence with which we are apt to regard them. It has lately been discovered that they chiefly inhabit barren stony places, where they subsist, for the most part, upon scorpions; to procure which they employ their hands to lift up the numerous loose stones, under most of which one or more of these creatures commonly lie concealed; their stings they extract with dexterity. Accordingly, we find that the Baboons are expressly modified for traversing the ground on all-fours, and are furnished with efficient hands; their eyes are peculiarly placed, directed downwards along the visage. Want of space necessarily prevents us, generally, from noticing these highly interesting relations, afforded by the special modifications of structure in reference to habit: but we avail ourselves of the present instance (which is little known*) to call attention to them.

With the Baboons, the series of CATARRHINI (Geof.) terminates; and we may observe that the *Simiadæ* fall under three principal divisions. First, that of the Apes, (comprising the Chimpanzee, Ourangs, and Gibbons), tail-less genera, which have the liver divided as in Man, an appendage to the cœcum, &c. Second, the slender-limbed Monkeys, with sacculated stomachs and longer intestines (or the Doucs, and most probably the Colobins), all of which have exceedingly long tails. Third, those with shorter and stouter limbs, a simple stomach, and tail varying in length from a tubercle to longer than the body. These last (or the true Monkeys, Macaques, Magots, and Baboons), are all partly insectivorous; and the habit mentioned of the Baboons, of turning over stones in quest of prey, applies perhaps more or less to all of them, but particularly to the Magot and some Monkeys. In the two first divisions, the coat consists of only one sort of hair; in the last of two sorts, the longer and coarser of which is mostly annulated with two colours. It is remarkable that none of the genera are common to Asia and Africa (one Baboon only extending to Arabia), and, until very recently, no remains of any had occurred in a fossil state; but the jaw of one said to be allied to the Gibbons has lately been detected in a tertiary deposit, at Sanson, France; and some bones, adjudged to be those of Macaques, in the tertiary ranges of northern India.]

THE MONKEY-LIKE ANIMALS OF THE NEW WORLD,

[PLATYRRHINI, *Geof.*],—

Have four grinders more than the others, thirty-six in all; the tail [with very few exceptions] long; no cheek-pouches; the buttocks hairy and without callosities; nostrils opening on the sides of the nose, and not underneath; [the thumbs of the anterior hands no longer opposable†.] All the great *Quadrumana* of America pertain to this division.‡ Their large intestines are less inflated, and their cœcum longer and more slender than in the preceding divisions.

The tails of some of them are prehensile, that is to say, their extremity can twist round a body with sufficient force to seize it as with a hand.§ Such have been designated SAPAJOUS (*Cebus*, Erxl.)

At their head may be placed the

STENTORS (*Mycetes*, Illiger),—

Or *Howling Monkeys* [*Alouattes* of the French], which are distinguished by a pyramidal head, the upper jaw of which descends much below the cranium, while the branches of the lower one ascend very high, for the purpose of lodging a bony drum, formed by a vesicular inflation of the hyoid bone, which communicates with their larynx, and imparts to their voice prodigious volume and a most frightful sound. Hence the appellations which have been bestowed on them. The prehensile portion of their tail is naked beneath.

[The Rufous Stentor (*Sim. seniculus*, Buff., Supp. vii. 25), the Ursine Stentor (*Stentor ursinus*, Geoff.), and at least five other species, are now tolerably established. They are shaggy animals, averaging the size of a Fox, of different shades of brown or blackish, the females of some being differently coloured from the males; such is *M. barbatus*, Spix, pl. 32, of which the male is black and bearded, the female and young pale yellowish-grey.‖ They are of an indolent and social disposition, and grave deportment; utter their hideous yells and howling by night; subsist on fruits and foliage, and are deemed good eating.]

* For the information communicated, we are indebted to Dr. A. Smith, the conductor of the South African expedition from the Cape colony.—ED.

† They are out slightly so in many of the *Simiadæ*.—ED.

‡ By this is meant, that the Marmosets and Tamarins (*Ouistitis* of our author) are excluded from the generalization.—ED.

§ This organ possessing in an eminent degree the sense of touch, where the character is most developed.—ED.

‖ Cuvier accordingly suggests, inadvertently, that the *M. stramineus* Spix, pl. 31, which is entirely of a straw-yellow colour, may be the female of some other; Spix, however, figures a male.—ED.

The ORDINARY SAPAJOUS have the head flat, the muzzle but slightly prominent (sixty degrees).

In some the anterior thumbs are nearly or quite hidden in the skin, and the prehensile portion of the tail naked beneath. They constitute the genus

COAITA (*Ateles*, Geof.),—

[Or the *Spider Monkeys*, as they are commonly termed, in allusion to their long slender limbs, and sprawling movements.]

The first species, the Chamek (*A. subpentadactylus*, Geof.), has a slight projection of the thumb, though only for one phalanx, which has no nail. Another, the Mikiri (*At. hypoxanthus*, Pr. Max.; *Brachyteles macrotarsus*, Spix), has also a very small thumb, and sometimes even a nail. These two species are separated by Spix under the name *Brachyteles*. They connect *Ateles* with *Lagothrix*.*

The others, to which alone Spix applies the name *Ateles*, have no apparent thumb whatever. [Six have been ascertained; one of them the *Sim. paniscus*, Lin.]

All the above are natives of Guiana and Brazil. Their limbs are very long and slender, and their gait slow and deliberate. They exhibit some remarkable resemblances to Man in their muscles, and, of all animals, alone have the biceps of the thigh made like his. [Accordingly, they make little use of their fore-hands in progression. Their colours are chiefly or wholly black, or fulvous-grey; face black, or flesh-coloured. They are gentle and confiding, and capable of much attachment. Some attain to as large a stature as the preceding.]

THE GASTROMARGUES (*Lagothrix*, Geof.; *Gastromargas*, Spix).

Head round, as in the Coaitas; the thumb developed, as in the Stentors; and tail partly naked, like the one and the other. Such are—

The Caparo, *Humb.* (*L. Humboldtii*, Geof.; *G. olivaceus*, Spix), and the Grison (*L. canus*, Geof.; *G. infumatus*, Spix.)—Inhabitants of the interior of South America, said to be remarkable gluttons. Their limbs are shorter and stouter than in the Coaitas, and they often raise themselves on their hinder extremities: occur in numerous bands.

The other Sapajous, or

THE CAPUCHINS (*Cebus*, Geof.)—

Have a round head, the thumbs distinct, and the tail entirely hairy, though prehensile. The species are still more numerous than those of the Stentors, and almost as difficult to characterize.

Some have the hair upon the forehead of a uniform length; as the Sajou (*Sim. apella*, Lin.), and the Capuchin, [*Auct.*] (*S. capucina*, Lin.): others have the hair of the forehead so disposed as to form aigrettes; as the Horned Capuchin (*Sim. fatuellus*, Gm., which has a tuft of black hairs on each side of the forehead), the *C. cirrhifer*, Geof., and the *Cebus* of the same name of Pr. Max., but which is different—*C. cristatus*, F. Cuv. There are numerous others; but we require many observations, made in the places where these animals inhabit, before we can hope to establish their species otherwise than in an arbitrary manner. [About sixteen are commonly admitted, most of which are of different shades of brown, some very variable. They are of smaller size than the preceding, and of mild and gentle disposition; their motions are quick and light, and they are easily tamed. Several exhale a strong odour of musk.]

In the SAIMIRI†, the tail is depressed, and almost ceases to be prehensile; the head is very much flattened; in the interorbital partition of the cranium there is a membranous space. Only one species is known,—

The Saimiri (*Sim. sciurea*, Buff. xv. 10.)—Size of a Squirrel; of a yellowish grey; the fore-arms, legs, and the four extremities, of a fulvous-yellow; end of the nose black. [A pretty, vivacious little animal, which subsists much on insects, and is also carnivorous. Its tail is sub-prehensile, or capable of coiling slightly throughout its length, and so holding in a moderate degree; but its extremity cannot seize a small object: it is often wound round the body.]

The remaining Monkey-like animals of America have the tail not at all prehensile.‡ Several have that appendage very long and tufted, whence they have been termed *Fox-tailed Monkeys*: their teeth project forwards more than in the others. They are

THE SAKIS (*Pithecia*, Desm. and Illig.),—

[Which are again divisible into three minor groups. Of these, the first is represented by the Yarke Saki (*Sim. Pithecia*, Lin., *P. leucocephala*), and three or four others: singular-looking animals, with extremely long hair, except on the head, where, in most of the genus, it is parted. In the Yarke, the head is whitish, and all the other parts brown-black, which adds to the strangeness of its appearance. The Jacket Saki (*Sim. sagulata*, Traill), illustrates

* The latter may do so, but certainly not the former, which is in all other respects a characteristic *Ateles*.—ED.

† *Sagoinus* (or, what would be preferable, *Sagunus*,) of some. This name, however, originally proposed by Lacepede for the Sagouins, (*Callithrix*), among which the Saimiri was included, can only lead to confusion if applied to the latter exclusively. We would suggest, therefore, the appellation *Samiris*, formed out of the vernacular.—ED

‡ It has a propensity to curl in the Marmosets, if not in the Sagouins.—ED.

the next group, which chiefly differs from the third (*Brachyurus*, Spix), in possessing a long tail: the hair is comparatively short, and in the Jacket Saki of a rich dark brown, except on the head, where it is longer, crisped, and deep black, as is also its fine bushy beard. Others would appear intermediate, as the *P. satanas*, Humb.: seemingly allied to which is the *Brachyurus israelitus* of Spix, and the diminutive *P. melanocephala* of Humboldt.* These last are represented as mainly frugivorous, and the first to be great destroyers both of wild bees and their honey. They are said to inhabit the very depth of the forest, and to repose during mid-day; are moderately social, and crepuscular if not nocturnal in their time of action.]

There are also some,

THE SAGOUINS (*Callithrix*, Geof.),—

The tail of which is slender, and the teeth do not project. They were a long time associated with the Saimiri, but the head of the Sagouins is much higher, and their canines considerably shorter. Such are

The Masked Sagouin (*C. personata*, Geof.), the Widow Sagouin (*C. lugens*, Humb.), [and several others; some of which have been ascertained to live in pairs, while others, (as the *C. melanochir*, Pr. Max.), assemble in numerous bands, and make a loud and unpleasant yelping about sunrise. They are very carnivorous, though small, and spring to a considerable distance on birds and other prey, for which they lie in wait; are also dexterous in seizing flying insects with the hand They have none of the sprightliness of the Saimiri.]

THE DOUROUCOULI (*Nocthorus*, F. Cuv.; *Nyctipithecus*, Spix: improperly named *Aotus* by Illiger),—

Only differ from the Sagouins by their great nocturnal eyes, and in their ears being partly hidden under the hair.

[Three species are now known, of somewhat Lemur-like appearance, but still having no particular relationship with the Lemurs. They are almost lethargic by day, which they pass in the darkest recesses of the hollows of trees; but at night are all energy and activity, and subsist on small birds and insects, as well as fruit: they drink little, and appear to live in pairs.]

All the foregoing animals are from Guiana or Brazil.

THE OUISTITIS (*Hapale*, Illiger),—

Constitute a small genus, similar to the Sakis, and which was long confounded in the great genus *Simia*. They have, in fact, like the American Monkey-like animals in general, the head round, visage flat, nostrils lateral, the buttocks hairy, no cheek-pouches; and, like the latter divisions of them in particular, the tail not prehensile: but they have only twenty grinders, like those of the old continent. All their nails are compressed and pointed, except those of the hinder thumbs [a character to which the immediately preceding divisions approximate], and their anterior thumbs are so little separated from the other digits, that we hesitate to apply the name *Quadrumana* to them. All are diminutive animals of pleasing forms, and are easily tamed. [Their brain is surprisingly low, almost without convolutions.]

M. Geoffroy distinguishes the *Ouistitis*, properly so called, by the name *Jacchus*. They are the

MARMOSETS (*Hapale*, as restricted),—

Which, for characters, have the inferior incisors pointed, and placed in a curved line, equalling the canines. Their tail is annulated, and well covered with hair; and their ears are generally tufted.

[Seven or eight species are tolerably established, some of which are subject to vary. These pretty little creatures are gregarious, and very indiscriminate feeders; are indeed rapacious, and in confinement will eagerly seize and prey on gold fishes, &c. They produce two or three young at a birth.]

M. Geoffroy designates as

TAMARINS (*Midas*),—

Those species which have inferior trenchant incisors placed in an almost straight line, and shorter than the canines. Their tail is also more slender, and not annulated.

[These differ more than the others, and are also somewhat variable in colour. At least seven or eight have been ascertained, of which the Pinche (*Sim. œdipus*, Lin.), is the longest known. Those curious little beings, the Silky Tamarin (*M. rosalia*), and the Leoncito, or *Lion Monkey* of Humboldt (*M. leoninus*), fall under this division.

* It is probable that all but the members of the first should range in the division *Brachyurus*, Spix, (provided this be separable,) which name is consequently ill-chosen.—ED.

All are restlessly active, and extremely rapid in their movements; also remarkably short-tempered, bristling with fury when enraged, and putting on a most formidable appearance, considering their size. They are so cleanly, that any appearance of dirt about their habitations causes them to fret; and are exceedingly sensitive of damp: but, if duly attended to, are easily kept in captivity.

The PLATYRRHINI were very properly ranged by Buffon in two great natural divisions, named by him SAPAJOUS and SAGOUINS; to the latter of which the *Ouistitis* are strictly referable, to judge from the aggregate of their conformation. We cannot but think that Cuvier has, in this rare instance, attached undue importance to the number of molar teeth, in so decidedly separating the *Ouistitis* from the other small American *Quadrumana*.]

THE LEMURS, (*Lemur*, Linn.),
[STREPSIRRHINI, *Geof.*],—

Comprehend, according to Linnæus, all the *Quadrumana* which have [supposed] incisors in either jaw differing in number from four, or at least otherwise directed than in the Monkeys. This negative character could not fail to embrace very different beings, while it did not unite those which should range together. M. Geoffroy has established several better characterized divisions in this genus. The four thumbs of these animals are well developed and opposable, and the first hind finger is armed with a raised and pointed claw (fig. 4), all the other nails being flat. Their covering is woolly; and their teeth begin to exhibit sharp tubercles, catching in each other, as in the *Insectivora*. [These animals have been described to differ from all other *Mammalia* in the circumstance of their upper canines locking outside or before the lower: but we have just discovered that their true inferior canines have always hitherto been mistaken for additional incisors, which they resemble in general aspect and direction; while the succeeding tooth, which from its size and appearance has been supposed to be the lower canine, is in reality the first false molar; (as will readily appear on opposing the successive teeth of both jaws). In the genus *Tarsius*, however, the true canine assumes more of its ordinary form; and the same is observable of the first false molar in *Microcebus*.* The grinding motion of the lower jaw is exceedingly reduced.]

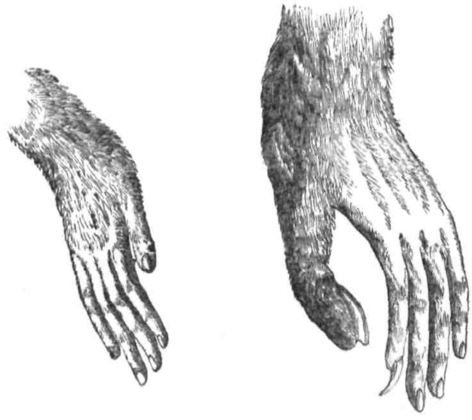

Fig. 4.—Hand and Foot of Lemur

THE LEMURS, properly so called (*Lemur*, as restricted [*Prosimia*, Briss.]),—

Have six [four] lower incisors, compressed, and slanting forwards [as are also the canines]; four in the upper jaw, which are straight, those intermediate being separated from each other; trenchant [upper] canines; six molars on each side above, and six below†; the ears small. They are very nimble animals, and have been designated *Fox-nosed Monkeys*, from their pointed heads. They subsist on fruits. Their species are very numerous, and inhabit only the island of Madagascar, where they appear to replace the Monkey-tribe, which, it is said, do not exist there. They differ but slightly among themselves, except in colour.

[Thirteen, at least, have been ascertained definitively; one of the longest known of which is the Macaco of Buffon, or the Ring-tailed Lemur (*L. catta*, Lin.), which is ash-grey, the tail annulated black and white. Others are black, or rufous, with sometimes white; and one beautiful species, the Ruffed Lemur (*L. macaco*, Lin.), is

* An approach to this deviation on the part of the inferior canine is noticeable in the adult Mandrill.—ED.

† The latter statement chances to be correct, but, as intended would have been erroneous —ED

varied with large patches of black on a pure white ground. They average the size of a large Cat, but have longer limbs; and have all long tails, which are elevated in a sigmoid form, when in motion, and not trailed after them. They are nocturnal or twilight animals, which sleep by day in a ball-like figure, perched on a bough; are gentle in disposition, and easily tamed; but have much less intelligence than the Monkeys, and are without the prying, mischievous propensities of those animals: their ordinary voice is a low grunt, but they often break forth into a hoarse abrupt roar, producing a startling effect; in their native forests they frequently thus roar in concert.]

THE INDRIS (*Lichanotus*, Illiger)—

Have teeth as in the preceding, except that there are only four [two] lower incisors [the central probably soon falling. Their hinder limbs are extremely long; the head broad, muzzle short, and hands long.]

But one species is known, without tail [this appendage being reduced to a tubercle], three feet in height, black, with the face grey, and white behind (*Lemur indri*, Lin., *Indris brevicaudatus*, Geof.), which the inhabitants of Madagascar tame, and train to the chace like a Dog. The Long-tailed Indri (*Lemur laniger*, Gm.) needs further examination.

[The latter appears to be very intimately allied to a species, with a naked face, named *Propithecus diadema* by Bennett, (*Macromerus typicus*, Smith,) the systematic characters of which seem hardly to warrant its separation from the Indris. Both are natives of Madagascar, and it is doubtful whether the present genus should not precede the last. The Short-tailed Indri is the most human-like of its tribe.

THE MACAUCOS (*Microcebus*, Geof., *Galagoides*, Smith)—

Have the head round; muzzle short and pointed; ears moderate and erect; the fore-limbs small: four incisors above, the central larger; also four below, with similar projecting canines, as in *Lemur;* the upper canines are small and pointed; and the first inferior false molar is scarcely larger than the next: the cheek-teeth indicate a partly insectivorous regimen. Their scrotum is disproportionately large.

Two small species are known: the Murine Macauco (*Lemur murinus*, Pen.), which is Buffon's *Rat of Madagascar;* and the Brown Macauco (*M. pusillus*, Geof.; also *Galago madagascariensis*, Geof., *G. demidoffii*, Fischer, and *Otolicnus madagascariensis*, Schinz). The *Lemur cinereus*, Geof. and Desm. (*Petit Maki*, Buff.), may perhaps constitute a third. These little animals have much the aspect, and also the manners, of a large Dormouse, which they further resemble in nestling in the holes of trees, which serve them for a dormitory: during day they sleep rolled up in a ball, and only rouse from their torpor on the approach of twilight, but are then extremely agile and lively. Of their habits in a state of nature we know little, except that they are arboreal.]

THE LORIS (*Stenops*, Illiger)—

Have the teeth of the Lemurs, except that the points of their grinders are more acute; the short muzzle of a mastiff; body slender; no tail; large approximating eyes; the tongue rough. They subsist on insects, occasionally on small birds or quadrupeds, and have an excessively slow gait: their mode of life is nocturnal. Sir A. Carlisle has found that the base of the arteries of the limbs is divided into small branches, [anastomosing freely with each other,] as in the true Sloths, [the object of which appears to be to enable them to sustain a long continuance of muscular contraction. The same character occurs, however, in the *Cetacea*].

Only two species are known, both from the East Indies; the Short-limbed Loris (*Lemur tardigradus*, Lin.), and the Slender Loris (*L. gracilis*): the former has been made a separate genus of by Geoffroy, who styles it *Nycticebus;* but he is wrong in asserting that it has only two incisors in the upper jaw: the latter is remarkable for the disproportionate elongation of its limbs, and especially of its fore-arms. [These most singular animals are eminently nocturnal and arboreal, being incommoded by daylight; they are also very susceptible of cold, which makes them dull and inanimate. During the day, they sleep clinging to a branch, with the body drawn together, and head sunk upon the chest; at night they prowl among the forest boughs in quest of food. Nothing can escape the scrutiny of their large glaring orbs: they mark their victim, insect or bird, and cautiously and noiselessly make their advances towards it, until it is within the reach of their grasp; they then devour it on the spot, previously divesting it, if a bird, of its feathers. When rousing from their diurnal slumbers, they delight to clean and lick their full soft fur; and in captivity will then allow themselves to be caressed by those accustomed to feed them: they are remarkable for extreme tenacity of grasp.

THE POTTOS (*Perodicticus*, Bennett)—

Have comparatively small eyes; the ears moderate and open: dentition approaching that of the Lemurs; tail moderate; limbs equal; the index finger of the anterior hands (fig. 5) little more than rudimentary.

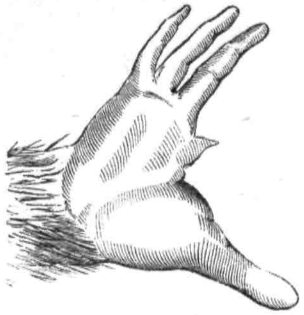

Fig. 5.—Hand of Potto.

Geoffroy's Potto (*Lemur potto*, Lin.; *Galago Gruntensis*, Desm.; *P. Geoffroyi*, Ben.)—From Sierra Leone; a slow-moving and retiring animal, which seldom makes its appearance but in the night-time, and feeds on vegetables, chiefly the Cassada.]

THE GALAGOS (*Otolicnus*, Illig.)—

Have the teeth and insectivorous regimen of the Loris; the tarsi elongated, which gives to their hinder limbs a disproportionate extent; tail long and tufted; large membranous ears [which double down when at rest, as in some Bats]; and great eyes, which indicate a nocturnal life. [The index, as well as the thumb of the anterior hand, inclines in some to be opposable to the other fingers.]

Several species are known, all from Africa; as the Great Galago (*Galago crassicaudatus*, Geof.), as large as a Rabbit; and the Senegal Galago (*G. Senegalensis*, Geof.), the size of a Rat. The latter is known as the *Gum animal* of Senegal, from its feeding much on that production. [These pretty animals have at night all the activity of birds, hopping from bough to bough, on their hind limbs only. They watch the insects flitting among the leaves, listen to the fluttering of the moth as it darts through the air, lie in wait for it, and spring with the rapidity of an arrow, seldom missing their prize, which is caught by the hands. They make nests in the branches of trees, and cover a bed with grass and leaves for their little ones: are a favourite article of food in Senegal. A species larger than the others has lately been received alive, *O. Garnottii* of Ogilby.]

THE MALMAGS (*Tarsius*)—

Have the tarsi elongated (fig. 6), and all the other details of form as in the preceding; but the interval between their molars and incisors is occupied by several shorter teeth [that is, their upper canines are very small; and] the middle upper incisors are elongated, and resemble canines. [There are but two permanent lower incisors, and the inferior canines present more of the ordinary form and direction.] Their muzzle is very short, and their eyes still larger than in any of the foregoing. [Tail very long, and almost naked.] Are also nocturnal animals, and insectivorous; inhabiting the Molluccas.

Fig. 6.—Foot of the Malmag.

[Two species are known, *T. spectrum*, Geof., (*Lemur tarsius*, Shaw; *T. fuscomanus*, Fischer,) and the *T. bancanus* of Horsfield. It is observed by Geoffroy that although the Malmags have the external ears much less developed than in the Galagos, this inferiority is counterbalanced by the far greater volume of the auditory *bullæ* of the temporal bones, which are so developed as to touch each other; and thus the sense of hearing is, by another mode, rendered as acute in the former as in the latter. The Malmag has an aversion to light, and retires by day under the roots of trees; feeds chiefly on lizards, and leaps about two feet at a spring; is easily tamed, and capable of some attachment; holds its prey in its fore-hands, while it rests on its haunches; produces one young at a birth, and lives in pairs.]

Travellers should search for certain animals figured by Commerson, and which Geoffroy has engraved (*Ann. Mus.* xix. 10), under the name of

CHEIROGALES (*Cheirogaleus*).

These figures seem to announce a new genus or subgenus of *Quadrumana*. [Three species are represented in Commerson's drawing, all of which appear to be now authenticated by specimens. Their proportions are those of the Galagos; dentition as in the Malmags, except that they retain all their inferior incisors; the head is round, the nose and muzzle short, lips furnished with whiskers, the eyes large and approximate, and the ears short and oval; the nails of the four extremities are compressed and somewhat claw-like, and the tail is long, bushy, and regularly cylindrical.

Three or more species are known, all from the great island of Madagascar. They constitute the division *Lichanos* of Gray.

The singular genus *Cheiromys*, also, from the same peculiar locality, which is arranged by the author among the *Rodentia*, would appear to have much better claim to be introduced here, and near

to the Galagos. Likewise, *Galæopithecus*, which Cuvier has placed after the Bats, but which is Lemurine in all the essential details of its conformation.*]

THE THIRD ORDER OF MAMMALIANS,—

CARNARIA †,—

Consists of an immense and varied assemblage of unguiculated quadrupeds, which possess, in common with Man and the *Quadrumana*, the three sorts of teeth, but have no opposable thumb to the fore-feet.‡ They all subsist on animal food, [some Bats excepted,] and the more exclusively so, as their grinders are more cutting. Such as have them wholly or in part tuberculous, take more or less vegetable nourishment, and those in which they are studded with conical points live principally upon insects. The articulation of their lower jaw, directed crosswise, and clasping like a hinge, allows of no lateral motion, but can only open and shut: [the latter, however, had already been nearly lost in the Lemurs.]

Their brain, though still tolerably convoluted, has no third lobe, and does not cover the cerebellum, any more than in the following families; the orbit is not separated from the temporal fossa in the skeleton §; the skull is narrowed, and the zygomatic arches widened and raised, in order to give more strength and volume to the muscles of the jaws. Their predominant sense is that of smell, and the pituitary membrane is generally spread over numerous bony laminæ. The fore-arm is still capable of revolving in nearly all of them, though with less facility than in the *Quadrumana*. The intestines [save in the frugivorous Bats] are less voluminous, on account of the substantial nature of the aliment, and to avoid the putrefaction which flesh would undergo in a more extended canal: [besides which, the requisite nutriment is more readily extracted from it.]

As regards the rest, their forms and the details of their organization vary considerably, and occasion analogous differences in their habits||, insomuch that it is impossible to arrange their genera in a single line; and we are obliged to form them into several families, which are variously connected by multiplied relations.

* Here, at the end of the *Quadrumana*, may be appended some information, which unfortunately arrived too late for insertion under the generic heads *Cercopithecus* and *Colobus*.

It has just been ascertained, by Mr. Martin, that the MANGABEYS (*Cercopithecus æthiops* and *fuliginosus*, Auct.) possess the additional tubercle on the last molar, found in the Macaques, Doucs, &c.; whence the name *Cercocebus* may now be continued to them exclusively, as a definite subordinate group, more nearly related to the true Monkeys than to the Macaques, notwithstanding the structural character adverted to. Their hair, it may be remarked, is not grizzled or annulated, as in both the Macaques and Monkeys.

Of the genus *Colobus*, a perfect skin of *C. leucomeros*, Ogilby, has been received in Paris, which securely establishes that species. The face is encircled with white hair, very long on the sides; and the tail also is white, as in *C. ursinus*.

Finally, a notice and figure have been just published of a species designated *Colobus verus*, but which appears to me, both from its contour and the description (which states its hair to be annulated), to be a thumbless *Cercopithecus*, allied to *C. Campbellii*. The negative character of wanting a thumb, only, will not constitute a *Colobus*.—ED.

† Written *Carnassiers* by Cuvier.—ED.

‡ In one genus of *Cheiroptera* (*Dysopes*), the hinder thumbs of some of the species incline to be opposable; while the last trace of this character in the anterior limbs, would seem to be the freedom of the thumb in the Bats generally, their fingers being all connected by membrane.—ED.

§ At least not generally: but it is commonly so in the Mangoustes (*Herpestes*), and allied genus *Cynictis*; also in the *Felis planiceps*: it is nearly so in the frugivorous *Cheiroptera*, and, it would seem, in *Taphozous* among the insectivorous Bats.—ED.

|| This is a favourite mode of expression of our author; but we have reason rather to transpose the sequency, or, in other words, to regard the habit as necessitating the particular modifications of structure. Thus, on consideration, it will appear, that the productive powers of nature ever exceeding the actual demand for such multiplication, species upon species have been endowed with the necessary organization to aid as successive checks upon

THE FIRST FAMILY OF CARNARIA,—

CHEIROPTERA,—

Preserves some affinities with the *Quadrumana* by the pendulous penis*, and mammæ which are placed on the breast. Their distinctive character consists in a fold of the skin, which, commencing at the sides of the neck, extends between their four feet and their fingers, sustains them in the air, and even enables such of them to fly as have the hands sufficiently developed for that purpose.† This disposition required strong clavicles, and large scapulars, to impart the requisite solidity to the shoulder; but it was incompatible with the rotation of the fore-arm, which would have diminished the force of the stroke necessary for flight. These animals have all four large canines, but the number of their incisors varies. They have long been distributed into two genera, according to the extent of their organs of flight‡ [sustaining membrane]; but the first requires numerous subdivisions.

THE BATS (*Vespertilio*, Lin.)—

Have the arms, fore-arms, and fingers excessively elongated, so as to form, with the membrane that occupies their intervals, real wings, the surface of which is equally or more extended than in those of Birds. Hence they fly very high, and with great rapidity. Their pectoral muscles have a thickness proportioned to the movements which they have to execute, and the sternum possesses a medial ridge to afford attachment to them, as in Birds. The thumb is short, and furnished with a crooked nail, by which these animals creep and suspend themselves. Their hinder parts are [generally] weak, and divided into five toes, nearly always of equal length, and armed with trenchant and sharp nails. They have no cœcum to the intestine. Their eyes [except in the frugivorous species] are extremely small, but their ears are often very large, and constitute with the wings an enormous extent of membrane, almost naked, and so sensible that the Bats guide themselves through all the intricacies of their labyrinths, even after their eyes have been removed, probably by the sole diversity of aërial impressions.§ They are nocturnal animals, which, in our climates, pass the winter in a torpid state. During the day they suspend themselves in

Fig. 7.—Skeleton of Bat.

superfluity, it being clear, speaking generally, that the consumed must have pre-existed to the consumer; or, to embody the proposition in still more general terms, the conditions must have been first present, in especial reference to which any species has been organized: in conformity with which theorem, it may be remarked, that, however reciprocal, on a superficial view, may appear the relations of the preyer and the prey, a little reflection on the observed facts suffices to intimate that the relative adaptations of the former only are special, those of the latter being comparatively vague and general; indicating that there having been a superabundance which might serve as nutriment, in the first instance, and which, in many cases, was unattainable by ordinary means, particular species have therefore been so organized (that is to say, modified upon some more or less general *type* or plan of structure,) to avail themselves of the supply; which special adaptation, however, does not necessarily prevent them (in a vast proportion of cases) from also deriving nourishment from other sources. Hence, therefore, the organization should be considered as having reference to, rather than as occasioning the particular habit.—ED.

* This organ, however, as in the *Carnivora*, contains a bone (though only within the glans,) with its accompanying pair of muscles.—ED.

† This character applies to all, with the exception of the Colugo (*Galæopithecus*), a genus which has little claim to range in this division.—ED.

‡ This term is inapplicable to the *parachute* membrane of the Colugo.—ED.

§ I have reason to suspect that the delicate tact alluded to resides principally in the facial membrane, present in only some genera. A specimen of *Vesp. Nattereri*, which I have just been observing, (in which restricted genus there is no developement of membrane on the face,) has several times, in flying about the room, flapped against a glass case.—ED.

obscure places. Their ordinary produce is two young at a birth, [one only in the frugivorous species, and many others,] which cling to the mammæ of their parent, [have their eyes closed for a while,*] and are of large proportional size. They form a very numerous genus, presenting many subdivisions. First there require to be separated—

THE ROUSSETTES (*Pteropus*, Briss.),—

Which have cutting incisors to each jaw, and grinders with flat crowns, or rather the latter have originally two longitudinal and parallel projections, separated by a groove, and which wear away by attrition: accordingly they subsist in great part upon fruits, of which they consume a vast quantity; they also ably pursue small birds and quadrupeds: [a statement which much requires confirmation.] They are the largest of the tribe, and their flesh is eaten. The membrane is deeply emarginated between their legs, and they have little or no tail; their index finger, shorter by half than the middle one, possesses a third phalanx, bearing a short nail (see fig. 9), which are wanting in other Bats; but the following fingers have each only two phalanges; [their thumb is proportionally very large]; they have the muzzle simple, the nostrils widely separated, the ears middle-sized and without a tragus, and their tongue studded with points that curve backwards; their stomach is a very elongated sac, unequally dilated, [and their intestines are much longer than in other Bats.] They have only been discovered in the south of Asia and the Indian Archipelago; [now, however, also in Japan, Australia, Madagascar, and the south and west of Africa.

The species are very numerous, and have been greatly elucidated by the investigations of Temminck and others, who have established most of them on a considerable number of specimens of all ages, and many anatomically. They produce early, and the sexes are separately gregarious, the young also associating apart from their parents as soon as they can provide for themselves.†] They divide into

1. Tailless Roussettes, with four incisors to each jaw; all of which were comprehended by Linnæus under his *Vespertilio vampyrus*. [More than twenty species are known, some of which exceed five feet across. One of the commonest in collections is]

The Black-bellied Roussette (*Pt. edulis*, Geof.)—Of a blackish brown, deeper beneath [the fur crisp and coarse]; nearly four feet in extent [sometimes, according to Temminck, upwards of five feet French, corresponding to five feet and a half English]. It inhabits the Moluccas and Isles of Sunda, where they are found during the day suspended in great numbers to the trees. To preserve fruit from their attacks, it is necessary to cover it with nets. Their cry is loud, and resembles that of a Goose. They are taken by means of a bag held to them at the end of a pole; and the natives esteem their flesh a delicacy; but Europeans dislike it on account of its musky odour. The flesh of the Common Roussette (*Pt. vulgaris*, Geof.), an inhabitant of the Mauritius, has been compared to that of the Hare and Partridge.

Fig. 8.—Head of Pteropus edulis.

2. Roussettes with a short tail, and four incisors to each jaw: [also generally less than the smaller species of the preceding. At least six are known, one of which only (*Pt. amplexicaudatus*), has the tail moderately conspicuous: the muzzle is comparatively somewhat shorter. These two divisions comprehend all that are now ranged in *Pteropus*; and one species only (*Pt. macrocephalus*, Ogilby), from the Gambia, presents any marked departure from the general character, in the great size of its head, the superior magnitude and solidity of its canines, and separation of the molars: allied to it is *Pt. gambianus*, Ogilby, from the same locality, and *Pt. Whitei*, Ben., which has a singular tuft on each side of the neck. The name *Epomophorus*, Ben., is applied to these three species by Gray.]

3. According to the indicia of M. Geoffroy, we now separate from the Roussettes

THE CEPHALOTS (*Cephalotes*, Geof.),—

Which have [nearly] similar grinders, but in which the index finger, short, and consisting of three

* Perhaps the frugivorous species form an exception to this. The others are naked at birth, but have the limbs strong, and adapted for clinging to their parent.

† The same appears to be the case with some of the insectivorous Bats of Europe.—ED.

phalanges, like that of the preceding, has no nail. The membranes of their wings, instead of meeting at the flank, are joined to each other at the middle of the back, to which they adhere by a vertical and longitudinal partition [a character which occurs, however, more or less completely, that is, the volar membrane is attached more or less near to the middle of the back, in some of the Roussettes]. They have often only two incisors [when adult, which are inserted in small curved intermaxillaries, that are moveable backwards and forwards].

"M. Isidore Geoffroy, in a monograph of this genus [*Pteropus*], forms the *Pt. personatus*, Tem., and some allied species, into the subgenus *Pachysoma*, which has four molars less than the others, and the zygomatic arches more projecting: the *Pt. minimus* or *rostratus* composes his subgenus *Macroglossus*, the muzzle of which is longer and more slender, and there are spaces between the grinders; it is believed that the tongue is extensile [now known to be slightly so, and of a rather longer and more acuminate form than in the others]. Lastly, he separates the Cephalot of Peron from that of Pallas, and applies to the former the name *Hypodermis*, on account of the complete dorsal insertion of the membranes of its wings."*

[M. Temminck, in his excellent monograph of the *Pteropidæ*, or frugivorous Bats (published in 1835), adopts, as generic, the divisions *Pteropus*, *Pachysoma* (*Cynopterus*, F. Cuv.), *Cephalotes*, Geof. (*Hypodermis*, Is. Geof.), *Harpyia*, Illiger (*Cephalotes*, Is. Geof.), and *Macroglossus*.† Six species are known of *Pachysoma*, which present some other peculiar characters, and vary in size from ten to twenty inches across: the remaining three respectively consist of one known species only, viz., *C. Peronii*, sometimes two and a half feet in extent,—*H. Pallasii* (fig. 9), a singular looking animal, from Timour, fourteen inches across, with a claw on its fore-finger (like the Cephalot), and projecting tubular nostrils, — and *M. rostratus*, the Kiodote, the smallest of the tribe, rarely measuring a foot in spread of wing, and which is known to subsist chiefly on the fruit of the Clove (*Eugenia*); its grinders are remarkably diminutive. Between these frugivorous *Cheiroptera* and the following genera, the lapse is very considerable.]

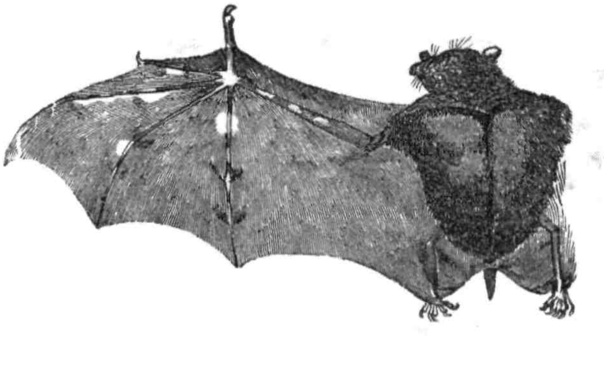
Fig 9 – Harpyia Pallasii.

The Roussettes having been detached, the genuine Bats remain, all of which [excepting *Desmodus*] are insectivorous, and possess three grinders on each side of both jaws, beset with conical points, and preceded by a variable number of false molars. Their index never has a nail, and, a single subgenus excepted, the membrane always extends between their hind-legs. [The greater number have cheek-pouches, and most, if not all, emit a peculiar low clicking note.]

They should be divided into two principal tribes: the first having three bony phalanges to the middle finger of the wing, while the other finger and the index even have only two. To this tribe which is almost exclusively foreign, belong the following subgenera:—

THE MOLOSSINES (*Molossus*, Geof. *Dysopus*‡, Illig.)

These have the muzzle simple; the ears broad and short, arising near the angle of the lips, and uniting with each other upon the muzzle; the tragus short, and not enveloped by the conch. Their tail occupies the whole length of the interfemoral membrane, and very often extends beyond it. [Their wings are narrow, and body large and heavy.] It is seldom that they have more than two incisors to each jaw: but, according to M. Temminck, several of them have at first six below, four of which they successively lose.

* This passage occurs in the Appendix to the original work.—ED.

† The term *Macroglossus*, however, has unfortunately been preoccupied in Entomology; for which reason *Kiodotus* (the common name of the species, latinized) may be proposed in its stead. *Harpyia* is likewise used in Ornithology, where another appellation must be substituted.—ED.

‡ This term is more generally accepted.—ED.

The *Dinops* of M. Savi refers to these Molossines with six inferior incisors. There is one of them in Italy (*Dinops cestonii*, Savi).

M. Geoffroy has applied the name *Nyctonomus* to those which have four inferior incisors.

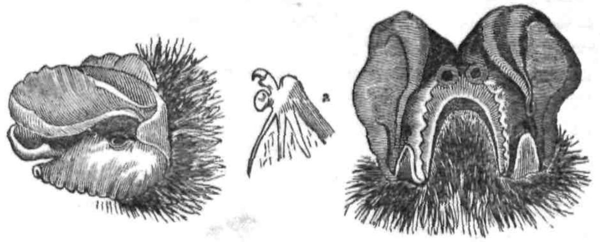

Fig. 10.—Head of Dysopus tenuis.

The Molossines were at first discovered only in America; but we now know several from both continents. Some of them have the hinder thumb placed farther from the other digits than these are from each other, and capable of separate motion; a character on which, in one species where it is very strongly marked, Dr. Horsfield has established his genus *Cheiromeles* [the ears of which, also, differ in being widely separated].

It is probable that we should also place here the *Thyroptera* of Spix, which appears to have several characters of the Molossines, and the thumb of which has a little concave palette peculiar to them (fig. 10, a), by which they are enabled to cling more closely. [Several species of this genus agree in possessing this appendage, which is proportionally larger in the young.

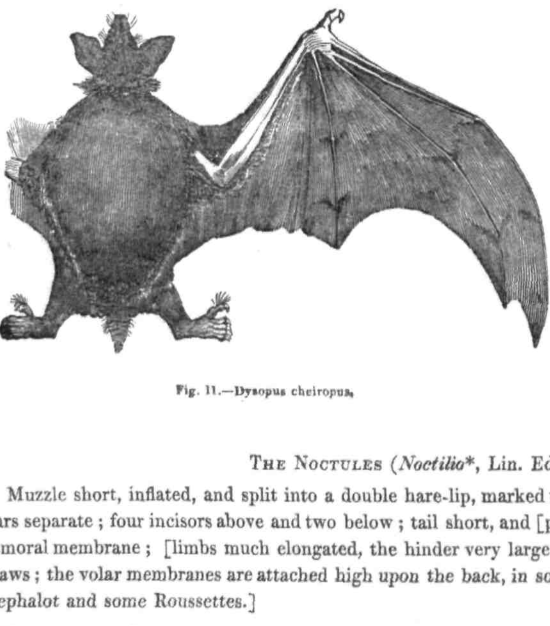

Fig. 11.—Dysopus cheiropus.

As a whole, the group of Molossines is extremely distinct and insulated, though consisting of a vast number of species, of which about twenty may be considered established; six or seven of these appertain to the eastern hemisphere. The largest and most curious of them is *D. cheiropus*, Tem. (*Cheiromeles*, Horsf., fig. 11), from Siam, which measures nearly two feet across: it is quite naked, with the exception of an abrupt collar of hairs round the neck.

Several have the upper lip laterally pendent (fig. 10), whence the name *Molossus* or Mastiff; and the term *Dysopus* refers to the toes being more or less tufted with hair. The greater number of species are from Brazil and Paraguay.]

THE NOCTULES (*Noctilio**, Lin. Ed. xii.)

Muzzle short, inflated, and split into a double hare-lip, marked with odd-looking warts and grooves; ears separate; four incisors above and two below; tail short, and [possibly in some] free above the interfemoral membrane; [limbs much elongated, the hinder very large and stout, and furnished with strong claws; the volar membranes are attached high upon the back, in some almost meeting dorsally, as in the Cephalot and some Roussettes.]

The most generally known species is from America (*Vesp. leporinus*, Gm.), of a uniform fulvous. [Others have been found on the same continent: and *Celæno*, Leach, was founded on an imperfect specimen, which is still extant. The Noctules are allied to the true Bats (*Vespertilio*); and a group which appears to be somewhat intermediate, but with a more elongated muzzle, is the *Emballonura*, Kuhl (*Proboscidea*, Spix), of which four species have been described from South America, and a fifth from Java. *Pteronotus*, Gray, is probably a Noctule, with a longer tail than usual; and *Myopteris*, Geoff., and also *Aëllo*, Leach, do not seem to differ essentially.]

THE PHYLLOSTOMES (*Phyllostoma*, Cuv. and Geoff.)

The regular number of incisors is four to each jaw, but some of the lower ones frequently fall, being forced out by the growth of the canines; [the second false molar is generally elongated]. They are, moreover, distinguished by the membrane, in the form of an upturned leaf, which is placed across the end of the nose. The tragus of their ear (fig. 12) resembles a leaflet, more or less indented. Their tongue, which is very extensile, is terminated by papillæ, which appear to be arranged so as to form

* The division *Noctilio* was unaccountably ranged by Linnæus among his *Glires*, or the *Rodentia* of our author.—ED.

an organ of suction; and their lips also have tubercles symmetrically arranged. They are American animals, which run along the ground with more facility than the other Bats, and have a habit of sucking the blood of animals.

1. Tailless Phyllostomes (*Vampyrus*, Spix).

The Vampyre [of authors] (*Vesp. spectrum*, Lin.)—(fig. 12.) This animal is reddish-brown, and as large as a Magpie. It has been accused of causing the death of men and animals by sucking their blood; but the truth appears to be, that it inflicts only very small wounds, which may sometimes prove dangerous from the effects of the climate. [There are several others, certain of which compose the divisions *Madatæus* and *Arctibeus*, Leach, *Lophostoma*, Orb., (which is very like a *Desmodus* externally,) *Diphylla*, Spix, and *Carollia*, Gray,—founded on trivial modifications of the form of the nose-leaf, tragus, and interfemoral membrane.]

2. Phyllostomes with the tail enveloped in the interfemoral membrane.

The Javelin Ph. (*Vesp. hastatus*, Lin.)—The leaf shaped like the head of a javelin, with its edges entire. [Also various others, some of which constitute *Macrophyllum* and *Brachyphylla*, Gray.]

3. Phyllostomes with the tail free above the membrane.

Ph. crenulatum, Geof.—The leaf indented on the side.

Fig 12.—Vampyrus spectrum.

M. Geoffroy distinguishes from the Phyllostomes those species which have a narrow extensile tongue, furnished with papillæ resembling hairs. He designates them GLOSSOPHAGUES (*Glossophaga*). All the species are likewise from America. [These also have been subdivided, according to the presence or absence of a short tail, and other frivolous characters into *Phyllophora* and *Anoura*, Gray, *Monophyllus*, Leach, and *Glossophaga*, as restricted. Spix applies to one of them (*Gl. amplexicaudata*, *Phyllophora* of Gray) the term *Sanguisuga crudelissima*,—"a very cruel blood-sucker." According to Mr. Bell, the tongue of Phyllostoma, has "a number of wart-like elevations, so arranged as to form a complete circular suctorial disc, when they are brought into contact at their sides, which is done by means of a set of muscular fibres, having a tendon attached to each of the warts." The teeth of these animals, however, are decidedly ill-adapted for blood-letting.

THE TRUE VAMPYRES (*Desmodus*, Pr. Max., *Edostoma*, Orb., *Stenoderma* ?, Geof.)

This extraordinary genus has two immense, projecting, approximate upper incisors, and similar lancet-shaped superior canines, all of which are excessively sharp-pointed, and arranged to inflict a triple puncture, like that of a Leech; four bilobate inferior incisors, the innermost separated by a wide interval; the lower canines small and not compressed: there are no true molars, but two false ones on the upper jaw, and three on the lower, of a peculiar form, apparently unfitted for mastication (fig. 13). The intestine is shorter than in any other known animal; as blood, which probably constitutes their sole food, is so readily assimilated.* They have the general characters of the Phyllostomes externally, a small bifid membrane on the nose, no tail or calcaneum, and the interfemoral membrane but little developed. Are also inhabitants of South America.

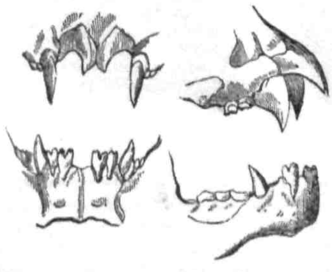

Fig. 13.—Teeth of Desmodus.

* In *Vespertilo noctula*, the intestine is only twice the length of the body, while in *Pteropus* it is full seven times. In *Desmodus*, it proceeds almost straight to the anus. It would be interesting to know the first or milk teeth of *Desmodus*.

Two or three species are known, of moderate but not large size.* One was taken in the act of sucking blood from the neck of a Horse, by Mr. Darwin. It is probable that their external similitude to the Phyllostomes has occasioned the latter to be accused of a sanguivorous propensity, for which their structure seems to be at most but partially adapted, while that of the present genus is obviously expressly designed for this mode of life. Compare the figures given of the dentition of the two genera.]

In the second grand tribe of Bats, the index has only one bony phalanx, while all the other fingers have two. This tribe also requires to be divided into several subgenera.

THE MEGADERMS (*Megaderma*, Geof.)—

Have the nasal membrane more complicated than in the Phyllostomes; the tragus large and most commonly bifurcated; the conch of the ears very ample, and joined together on the top of the head; the tongue and the lips smooth; interfemoral membrane entire, and there is no tail. They have four incisors below, but none above, and their intermaxillaries remain cartilaginous. [Their wings are remarkably ample, the whole cutaneous system of these animals being excessively developed.

Four species are known; two from Africa, the others from the Indian archipelago. One of the former (*M. frons*, fig. 14) has the body covered with long hair, of most delicately fine texture; it constitutes the division *Lavia* of Gray.] They are distinguished by the figure of the leaf, like the Phyllostomes.

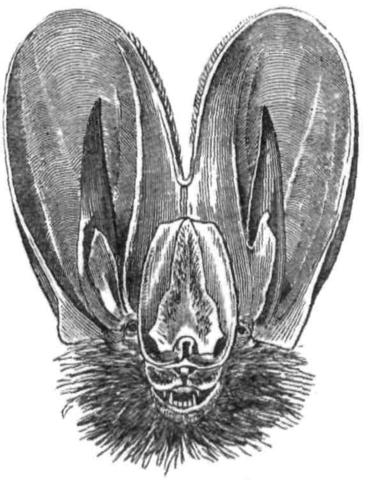

Fig. 14.—Megaderma frons.

THE RHINOLPHINES (*Rhinolophus*, Geof. and Cuv. [*Noctilio* Bechst.]), vulgarly termed *Horse-shoe Bats*.

These have the nose furnished with very complicated membranes and crests resting on the forehead, and altogether presenting [more or less] the figure of a horseshoe; their tail is long, and placed in the interfemoral membrane. They have four incisors below, and two small ones above, fixed in a cartilaginous intermaxillary.

Two species are very common in France [and found sparingly and locally in England†],—*Vesp. ferrum-equinum*, Lin., or *Rh. bifer*, Geof., and *Vesp. hipposideros*, Bechstein. They both inhabit quarries [cathedrals, &c.], where they hang solitarily [?] suspended by the feet, and enveloping themselves with their wings, so that no part of their body is visible. [They differ chiefly in size, but in this considerably; the larger measuring 13 inches across, the other 8½ inches.

More than twenty species are known, all from the eastern hemisphere. They fall under two divisions, of which the extremes are shown in the accompanying representation (fig. 15); but the majority are of intermediate character, like the two which inhabit Europe. Those with membranous crests have the tragus distinct, and sometimes considerably developed; the others have no separated tragus, and compose the divisions *Hipposideros*, Gray, (identical with *Phillorhina*, Bonap.) and *Asellia*, Gray: *Ariteus* of the same systematist referring to a member of the former sub-group, which is destitute of tail, and almost of interfemoral membrane; characters, however, to which other species approximate. They inhabit the darkest caverns, in vast multitudes, the sexes and young in separate assemblages. Penetrating to more deeply obscure recesses than any of the others, it is probable that their facial appendages are endowed with exquisite sensibility, for the still further extension of that delicacy of the sense of touch, by which others of this family are enabled to guide themselves when deprived of vision: the dryness of those membranes intimates that they are not olfactory. Certain inguinal glands, more or less distinctly developed in these animals, have been erroneously described as mammary teats.

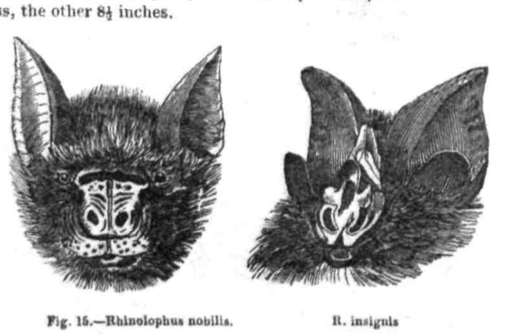

Fig. 15.—Rhinolophus nobilis. R. insignis

* There is reason to suspect that the genus *Desmodus* is much more extensively represented.—ED.

† A British locality, where both occur rather numerously, is the well-known cave near Torquay, in Devonshire, called *Kent's Hole*.

THE NYCTOPHILETS (*Nyctophilus*, Leach)—

Are, according to Temminck, somewhat intermediate to the Rhinolphines and the next genus of Nycterins; approaching the former in the character of their incisors and canines, and the latter in that of their molars: the ears are large and pointed; the tragus lanceolate; nasal follicles distinct; the tail moderately long, and enveloped in the membrane.

Nyct. Geoffroyi, Leach, is the only known species, from some part of Oceanica. It appears to be allied to the true Bats (*Vespertilio*), and was included in *Barbastellus*, Gray, as originally constituted.]

THE NYCTERINS (*Nycteris*, Cuv. and Geof.) —

Have the forehead furrowed by a longitudinal groove, which is even marked upon the cranium, bordered by a fold of the skin, which partially covers it; nostrils simple; four incisors without intervals above, and six below; ears large and separated; the tail involved in the interfemoral membrane [and terminated by a bifid cartilage (fig. 16, 2).] They are African species [for the most part, but one inhabits Java.

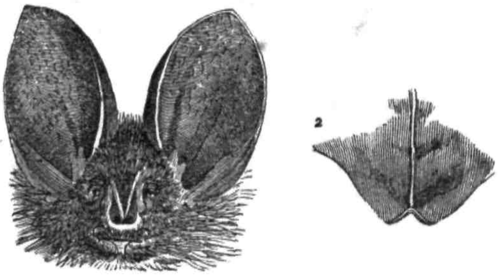

Fig. 16.—Head of Nycteris javanicus

These animals are remarkable for a power of inflating the skin, which is only attached to the body in some few places, by an open cellular connexion. There is a small aperture at the bottom of each cheek-pouch, by which this is effected; and the nostrils are so formed as to close when at rest, and to open only at will. By respiring with the mouth closed, the air passes through these apertures along the frontal groove to the upper part of the neck, and thence under the skin of the back, chest, and abdomen, which, by a repetition of the process, can be puffed out like a balloon: the intent remains to be explained.]

THE RHINOPOMES (*Rhinopoma*, Geof.)—

Have the frontal depression less marked; the nostrils at the end of the muzzle, with a little lamina above, forming a kind of snout; the ears are joined; and the tail [which is very slender] extends far beyond the interfemoral membrane.

[A few species occur on both continents, one of which is figured in the great French work on Egypt, under the name *Taphien filet*.]

THE TAPHIENS (*Taphozous*, Geof.)—

Have also a small rounded indenture on the forehead; but their nostrils have no raised lamina: the head is pyramidal, and there are only two incisors above, very often none, and four trilobate incisors below; their ears are widely separated, and [the tip of] their tail free above the membrane. The males have a transverse cavity under the throat. A little prolongation of the membrane of their wings forms a sort of pouch near the carpus.*

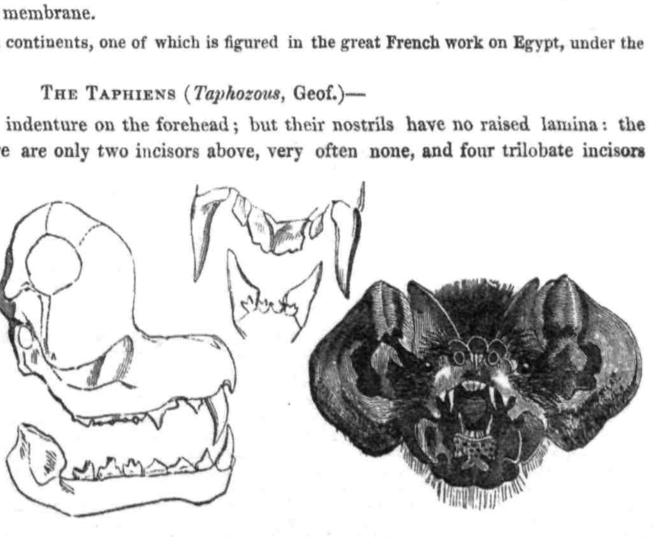
Fig. 17.—Mormoops Blainvillii.

One species was discovered in the catacombs of Egypt by M. Geoffroy [and it is probable that the others are peculiar to the old continent, though one (*Vesp. marsupialis*, Muller) is said to be American. *T. rufus*, Harlan (Wils. Am. Orn., vol. vi. pl. 50) is most likely a

* Hence the name *Saccopteryx*, applied to this genus by Illiger.

Vespertilio. The Egyptian species is represented to have small eyes; but that figured by Gen. Hardwicke (Lin. Trans., vol. xiv. p. 525) possesses eyes proportionally as large as in a Squirrel, and we have examined skins of another species (chinchilla-grey above, pure white beneath), in which the same character must have been conspicuous.]

THE MORMOPES (*Mormoops*, Leach)—

Have four incisors to each jaw, the superior rather large; the inferior trilobate: their skull (fig. 17) is singularly raised like a pyramid above the muzzle; and on each side of the nose is a triangular membrane, which extends to the ear.

The species *M. Blainvillii*, Leach, is from Java. [It has since been received, together with two others of the same form (but considered by Gray as separable), from Jamaica; so that the former locality may be presumed to be wrongly assigned.]

THE ORDINARY BATS [to which this term may be restricted] (*Vespertilio*, Cuv. and Geof.)—

Have no leaf or other distinctive mark on the muzzle, and the ears separated; four incisors above, of which the two middle ones are apart, and six below, sharp-edged, and somewhat notched*: their tail is comprehended in the membrane.

This subgenus is the most numerous of all, and universally distributed. There are six or seven species in France [more than double that number. Thirteen have now been met with in England, including the Barbastelle and Oreillard. The sexes and young of several congregate separately.†]

* M. Rousseau, in a memoir on the anatomy of *Vesp. murinus*, states, of the two dentitions of this animal, that the first is developed before birth, the second not till some time afterwards. The fœtal teeth, he remarks, are twenty-two in number; namely, four incisors, two canines, and four molars to the upper jaw, and six incisors, two canines, and four molars to the lower one. The permanent teeth, in the adult, are thirty-eight in number; of which twenty-two should replace the fœtal or temporary teeth; the sixteen others successively show themselves, later as their position is further backward. The permanent teeth do not wait to appear until their predecessors are shed, whence at a certain epoch forty or fifty teeth, or even more, may be counted in the same individual: this last fact we have observed in the instance of the common Fitchet Weasel.—ED.

† To facilitate the researches of the British naturalist, our known indigenous species may be briefly indicated. it is not unlikely that more remain to be discovered, as but few persons have hitherto bestowed much attention on these lucifugal animals.

The British species fall under two natural divisions.

In the first, the tragus is more or less rounded at the tip, short, and a little thickened in its substance; there are four pairs of false molars to each jaw. Such are

The Noctule Bat (*V. noctula*).—Of a bright reddish-brown; the membrane dusky. Length of the head and body nearly 3 inches: extent 13 or 14 inches. Ears oval-triangular, shorter than the head; the tragus not one-third the length of the ear, arcuated, and terminated in a broad rounded head; muzzle short, broad, and blunt. This species is not uncommon, and is even numerous in some districts: its flight is lofty, whence designated *altivolans* by White.

Hairy-armed Bat (*V. Leisleri*).—The fur long, bright chestnut above, brownish grey beneath, under surface of the flying membrane with a broad band of hair along the fore-arm. Length of the head and body 2½ inches; extent 11¼ inches. The ears oval-triangular, shorter than the head; tragus barely one-third the length of the ear, terminating in a rounded head. But one specimen is known to have been killed in England.

Particoloured Bat (*V. discolor*).—Fur reddish-brown above, with the tips of the hairs white; beneath, sullied white. Length of the head and body 2¾ inches; extent 10½ inches. Ears about two-thirds the length of the head, oval, with a projecting lobe on the inner margin; the tragus of nearly equal breadth throughout, rather more than one-third the length of the ear. It inhabits towns, and comes abroad early in the evening. The only native specimen was taken at Plymouth.

Pipistrelle Bat (*V. pipistrellus*, erroneously termed *V. murinus* by British writers till very lately).—This small species is the commonest of any; it is dark reddish brown, paler beneath. Length to the tail 1½ inch; extent 8¼ inches. Ears two-thirds the length of the head, oval-triangular, notched on the outer margin; tragus nearly half as long as the ear, almost straight, thickened, obtuse, and rounded at the apex. It runs with celerity, carrying its head near the ground, from which it rises with ease, and is active during the greater part of the year. The Pygmy Bat (*V. pygmæus*, Leach,) is evidently a young animal, and probably of this species.

The next has only two pairs of superior false molars.

The Serotine Bat (*V. serotinus*).—Fur chestnut-brown above, yellowish-grey beneath. Length of the head and body 2¾ inches; extent 12¼ inches. The ears oval triangular; shorter than the head, tragus semicordate, little more than one-third the length of the ear. The Serotine frequents uninhabited houses, the roofs of churches, &c. and sometimes hollow trees; flies steadily and rather slow, and is occasionally taken near London.

In the second group, the tragus is relatively longer, thin, narrow, and more or less pointed; and there are six pairs of false molars to each jaw.

Mouse-coloured Bat (*V. murinus*).—The fur reddish-brown above, dull white beneath. Length of the head and body 3½ inches; spread of wing 15 inches. Ears oval, broad at the base, becoming narrower towards the apex, as long as the head; tragus falciform, the inner margin straight, not quite half the length of the ear. This Bat is very common in France and Germany, but only one instance has been recorded of its occurrence in Britain.

Bechstein's Bat (*V. Bechsteinii*).— Fur reddish-grey above, greyish-white beneath. Dimensions, to the insertion of the tail, 2¼ inches; 11 inches across. Ears oval, rather longer than the head; tragus narrow, falciform, not half the length of the ear. The thumb longer than in the others. A woodland species, found occasionally in the New Forest, Hants.

Fringe-tailed Bat (*V. Nattereri*).— Fur brown above, whitish beneath. Length, to the tail, nearly 2 inches; extent 11 inches. Ears oblong-oval, about as long as the head; tragus narrow-lanceolate, nearly two-thirds the length of the ear; interfemoral membrane with the margin crenate and stiffly ciliated, from the end of the spur or calcaneum to the tail. Has been met with in several parts of the country.

Notch-eared Bat (*V. emarginatus*, Geof., not of Jenyns).—The fur reddish-grey above, ash-coloured beneath. Length of the head and body two inches; extent 9 inches. The ears oblong, as long as the head, with a notch and a small lobe on the outer margin; tragus awl-shaped, a little curved outward, more than half the length of the ear. One was killed near Dover.

Daubenton's Bat (*V. Daubentonii*,—*emarginatus* of Jenyns).—Fur soft, plentiful, brownish-black at the base; the surface greyish-red above, ash-grey beneath. Length of the head and body 2 inches; extent 9 inches. The ears oval, three-fourths the length of the head, very slightly notched on the outer margin, with a fold on the inner margin at the base; tragus narrow-lanceolate, rather obtuse, bending a little inward, half the length of the ear; tail longer than the body. Has been taken in several localities, and flies rapidly near the ground, or over stagnant water.

Whiskered Bat (*V. mystacinus*).—Fur blackish-chestnut above, dusky beneath; the upper lip furnished with a moustache of long fine hair. Length of the head and body 1¾ inch; extent 8½ inches. Ears oblong, bending outward, shorter than the head, notched on the outer margin; the tragus half the length of the ear, lanceolate, a little expanded at the outer margin near the base. Has also occurred in different parts of the country.

The above characters are chiefly compiled from Bell's British Quadrupeds, where figures and minute descriptions are given of each of them, together with full-sized representations of their heads. It may be remarked that only the last five are retained in *Vespertilio* by Mr. Gray, the others being included in his *Scotophilus*.—ED.

been remarked on cutting down the tree to which one was clinging, and seizing it before it could extricate itself from the branches. They produce generally two young at a birth; and their cry resembles the low cackle of a Goose.]

All the other *Carnaria* have the mammæ situated on the belly.

THE SECOND FAMILY OF CARNARIA,—

INSECTIVORA,—

Possess, like the *Cheiroptera*, grinders beset with conical points, and generally lead a nocturnal or subterraneous life: they subsist principally on insects, and in cold countries most of them pass the winter in a torpid state. They have no lateral membranes, as in the *Cheiroptera;* but the clavicles are never absent: their feet are short, and their movements feeble*; the mammæ are placed under the abdomen, and the penis in a sheath. None of them have a cœcum, and in running they all place the entire sole of the foot upon the ground.

They differ in the relative proportions and position of their incisors and canines.

Some have long incisors in front, followed by other incisors [along the sides of their narrow jaws], and canines, all shorter even than the molars; a kind of dentition, of which the Malmags, among the *Quadrumana*, have already afforded an example, and which somewhat approximates these animals to the Rodents: others have large separated canines, between which are placed small incisors, being the ordinary disposition of these teeth both in the *Quadrumana* and *Carnaria;* and these two systems of dental arrangement occur in genera otherwise very similar in the character of their teguments, in the form of their limbs, and mode of life.

[It is in this group that we are led to identify the canine tooth as simply the first of the false molars, which in some has two fangs; and, as in the Lemurs, to perceive that the second in the lower jaw is in some more analogous in size and character to an ordinary canine, than that which follows the incisors. The incisor teeth are never more than six in number, which is the maximum throughout *placental* Mammalia (as opposed to *marsupial*); and, in several instances, one or two pairs are deficient†: the canines, with the succeeding false molars, are extremely variable‡; but there are ordinarily three tuberculated molars posterior to the representative of the carnivorous or cutting grinder of the true *Carnivora*. The snout in the *Insectivora* is generally elongated.]

THE URCHINS, or HEDGEHOGS (*Erinaceus*, Lin.)—

Have the body covered with prickles instead of hairs. The skin of the back is furnished with such muscles that the animal, by inclining its head and feet towards the belly, is enabled to inclose itself as in a purse, presenting only its spines towards an enemy. Their tail is very short, and their feet have each five toes. They possess on each jaw six incisors, of which the middle are the longest; and on either side three false molars, three bristled true molars, and a small tuberculous tooth.

The European Urchin (*E. Europæus*, Lin).—A well known species, common in the woods and hedges. It subsists chiefly on insects, but also feeds partly upon fruit, by which at a certain age its teeth become worn: passes the winter in its burrow, whence it issues in the spring with an amplitude and complication of its *vesiculæ seminales* that is almost incredible. [It produces a variable number of young, sometimes six or seven, which are born with their eyes closed, and, what is remarkable, their ears also: their prickles are then thin, and few in number, white, and at first flexile and disposed backward; but they soon harden on exposure. The adults remain concealed till the evening, when they run about in search of prey, with an omnivorous appetite; they devour Toads, and have been known to destroy leverets.] Pallas has noticed as an interesting fact, that the Urchin eats hundreds of Cantharides without experiencing any ill effect, whereas a single one produces horrible agony in a Dog or Cat.

[Ten other species are now known, distributed over Asia and Africa, but not Madagascar. Some are of small size, and others have the ears considerably enlarged.

* In *Macroschelides*, the hind feet are lengthened, and announce agility; while the Banxrings are said to be as lively as a Squirrel.—ED.

† The forked incisors of the Shrews appear each to represent two teeth; and the analogues of the inferior central incisors, wanting in this genus, appear, in *Solenodon* and *Myogalea*, of small size, between the representatives of the long dentelated incisors of *Sorex*.

‡ It should be remarked that a single tooth with two fangs is often represented by two separate teeth, each with one fang.

THE SOKINAH (*Echinops*, Martin)—

Is a Madagascar animal, which differs chiefly from the Urchins in its dentition, having but four upper incisors, of which the medial are large, and placed before the others; the superior canines (or what may be designated as such) are tuberculated behind; there are five molars in all to each side of the upper jaw, longitudinally very short, but broad, a groove passing continuously along their crowns: two small lower canines, three inferior false molars inclining forward, and four true molars obtusely tuberculated.

E. Telfairi, Mart., is the only ascertained species; and the form may be regarded as subordinate to *Erinaceus*.]

THE TENRECS (*Centenes*, Illiger)—

Have the body covered with spines, like the Urchins [but more slender and bristle-like]; they do not, however, possess the faculty of rolling themselves so completely into a ball: they have no tail; their muzzle is very pointed, and their teeth are very different. On each jaw are from four to six incisors, and two large canines: next follow one or two small teeth, and four triangular molars with sharply tuberculated crowns. They are natives of Madagascar, one species having been naturalized in the Mauritius: are also nocturnal animals, which pass three months of the year in a state of lethargy, although inhabiting the torrid zone. Brugiere even asserts that it is during the greatest heats that they become torpid.

[Three if not four species have been ascertained; one of which, the Tendrac of Buffon (*Erinaceus setosus*, Lin.), with six incisors to each jaw, composes the *Ericulus* of Is. Geoffroy.

The foregoing genera have little or no tail, whereas the following have very long tails.]

THE GYMNURES (*Gymnura*, Vig. and Horsf. [*Echinosorex*, Blain.])—

"Appear to approach the Banxring in dentition, and the Shrews by the pointed muzzle and scaly tail. There are five unguiculated toes to each foot, and tolerably stiff [almost spinous] bristles growing among woolly hair, [resembling the close fur of the Shrews.] It can only be properly classed when its anatomy is known."* [The general aspect is that of a Tenrec, with a long, naked, and scaly tail. There are six incisors to each jaw, the medial above widely separated, large, and resembling canines; the others lateral, and successively smaller: those below are separated into two pairs, the middle ones being somewhat apart, and one smaller on each side. The canines are moderately large, and somewhat curved, those of the upper jaw having two fangs: next follow, on each jaw, two pairs of small false molars, succeeded by one larger above, and two below; and the true molars are four in number above and three below, square, and tuberculated as in the Urchin.

The only known species (*G. Rafflesii*) inhabits Sumatra, and is larger than the Urchin of Europe.

The various preceding genera have small but not minute eyes.

THE MACROSCELLES (*Macroscelides*, Smith; *Erinomys*, Blain.; *Rhynomys*, Lichst.)—

Compose a well-marked genus, somewhat resembling the Shrews, but with large eyes and more elongated hind-feet: their fur is long and soft, and of very fine texture. They have six (lateral) incisors to each jaw, minute canines, and on either side five sharply tuberculated molars. Their habits are diurnal, and they retreat into burrows or beneath stones on apprehension of danger.

Eight species are known, all from South Africa except one, which inhabits Algiers. They are called *Elephant Mice* in the Cape Colony.]

THE BANXRINGS (*Tupaia*, Raff.; *Cladobates*, Fr. Cuv. [*Glisorex*, Diard.; *Hylogale*, Tem.]),—

A genus lately characterized, from the Indian Archipelago, the teeth of which bear some resemblance to those of the Urchins, only that their middle superior incisors are proportionally shorter, and there are four to the lower jaw, more elongated, [and projecting forwards as in the Lemurs]; they also [do not] want the tuberculous tooth behind. These animals are covered with hair [soft and glistening, but not fine in texture], and have a long bushy tail; and, contrary to the habits of other *Insectivora*, they ascend trees with the agility of a Squirrel, but their pointed muzzle renders them easily distin-

* From the Appendix to the author's edition.—ED.

guishable, even at a distance. [The general form is not unlike that of the Marsupial genus *Myrmecobius:* and the bony orbits of the cranium are sometimes complete.

Three species are known, the T. *tana, sumatrana,* and *ferruginea,* all of which are well characterized by differences in the conformation of the cranium, in addition to external distinctions; they inhabit trees, and are lively and active animals.*

All the remaining genera have minute eyes.]

THE SHREWS (*Sorex*, Lin.)—

Are generally small, and covered with [soft] hair. Under this, on each flank, there is a band of stiff, closely-set bristles, from between which, during the rutting season, exudes an odorous fluid, the product of a peculiar gland. Their two middle superior incisors are hooked, and dentated at the base; the lower ones slanting and elongated: five small teeth follow on each side the first, and only two the second. There are besides, on each jaw, three bristled molars, and finally on the upper one a small tuberculous tooth. These animals retire to holes they burrow in the ground, which they scarcely leave till towards the evening, and subsist on worms and insects.

[We have observed them to be much about during the day, under shelter of close herbage, where their sibilant and insect-like cry notifies their presence, and have occasionally seen them venture forth from cover when all was quiet.† M. Duvernoy discovered that their incisors occupy, from the first, the position they maintain in after-life, but are enveloped for a while by the *periostæum* or investing membrane of the bone to which they are attached, through which the larger protrude some time before the others: he accordingly infers that these animals have no milk-teeth. The same naturalist divides this genus into

1. *Sorex,* Duv. (*Crocidura,* Wagl.; including *Myosorex,* Gray); wherein the edge of the long inferior incisors is unserrated; that of the upper notched, or with the spur appearing as a point behind; the small lateral teeth which follow are three or four in number, and diminish rapidly in size from the first to the last; none of the teeth being coloured. The ears are conspicuously developed, and the tail has always longer and coarser hairs mingled with the ordinary short ones. This group, which is very distinct, comprises all the numerous extra-European species, together with three (*S. araneus,* Geoff., *S. Etruscus,* Savi, and *S. leucodon,* Herm.) which are met with on this continent. None occur in the British islands. One of the most remarkable is *S. giganteus,* Is. Geof., from India, which approaches in size to the Black Rat, and has a follicle on each side, producing a pungent musky secretion.

The remainder have the ears buried in the fur, and consequently inconspicuous.

2. *Amphisorex,* Duv. (*Corsira,* Gray.)—Incisors of the lower jaw with the edge dentelated; those of the upper forked, the spur behind prolonged to a level with the point in front: the lateral small teeth which follow five in number, and diminishing gradually in size: all the teeth more or less coloured at the tips. The British species have till very recently been confounded together under the name *araneus,* which pertains to a continental member of the preceding division.‡

3. *Hydrosorex,* Duv. (*Amphisorex* and *Crossopus,* Gray.)—The inferior incisors with an entire edge; the upper notched, or with a spur appearing as a point behind: the lateral teeth which follow in the upper jaw four in number; the first two equal, the third somewhat smaller, and the fourth rudimentary: tips of all the teeth a little coloured. This division, which comprises the aquatic species, is less distinct from the second than both are from the first. *Crossopus* of Gray is indeed stated to have the lower incisors dentelated. The British species require further elucidation.§

The Shrews compose an exceedingly numerous genus, the first section of which appears to be almost generally diffused. They renew their covering both in spring and autumn, acquiring a longer and less glossy winter coat; and the mode of effecting this is rather peculiar, the change commencing at the head and proceeding backward, preserving a distinct cross line of demarcation throughout its progress. These animals are often found dead on foot-paths, and dry ditches, on spots devoid of herbage, the cause of which remains to be explained.

* It is remarkable that the Squirrels of the same region have very similar fur, both in colour and texture.

† The common Shrike (*Lanius collurio*) preys much upon our native species.—ED.

‡ Mr. Jenyns distinguishes them as follows: all are of a reddish-brown colour.

The Common Shrew (*A. rusticus,* Jenyns).—Snout and feet slender: tail moderately stout, nearly cylindrical, not attenuated at the tip, well clothed with hairs, which are very divergent in the young state, and never closely appressed. It appears principally to frequent dry situations—gardens, hedge-banks, &c.

Irish Shrew (*A. hibernicus,* Jenyns).—Admitted as a species doubtfully, until more specimens have been examined. It is allied to but apparently smaller than the last, with the colours more uniform, and tail shorter and more slender.

Square-tailed Shrew (*A. tetragonurus,* Herm.)—The snout broad, compared with that of the common Shrew: feet, the fore especially, much larger; the tail slender, more quadrangular at all ages, and slightly attenuated at the tip; clothed with closely appressed hairs in the young state, in age nearly naked: upper parts very deep reddish brown; below, dirty yellowish-grey. This species is more attached to marshy districts, though not confined to them.

Chestnut Shrew (*A. castaneus, Jenyns*).—*Snout and feet much as* in the last species, but the former rather more attenuated; tail moderately short, nearly round, well clothed with hairs, which form at the extremity a long pencil: upper parts, as well as the snout, feet, and tail, bright chestnut; under parts ash-grey. The cranium is broader posteriorly and rather more elevated in the crown than in *A. tetragonurus.* It inhabits the same marshy districts.

§ Mr Jenyns distinguishes the

H. fodiens, Gm.—Of a deep brownish-black above, nearly white beneath; the two colours distinctly separated on the sides feet and tail ciliated with white hairs. It inhabits marshes and banks in ditches, but is occasionally met with at a distance from water. It often seeks its prey at the bottom of pools under water, thus approximating in habit to the Desmans.

S. ciliatus, Sowerby (*remifer* of Yarrell, and doubtfully of Geoffroy).—Black above; greyish-black beneath; throat yellowish-ash colour feet and tail strongly ciliated with greyish hairs. Is found in the same situations as the preceding.

There is reason to suspect others, one or more marked with rufous on the under parts having been indicated by observers.—ED.

THE SOLENODON (*Solenodon*, Brandt)—

Resembles a gigantic Shrew, but with coarse fur, and proportionally much longer whiskers: the tail is long, naked, and scaly, and the claws considerably more developed. There are six incisors to each jaw, the first pair above, and the second pair below, very large, and resembling canines; two superior false molars, and three inferior, on each side; then five true molars above, and four below, subquadrate, and broad or transverse.

The species, *S. paradoxus*, Brandt, inhabits Hayti, and is larger than the Brown Rat.]

THE DESMANS (*Mygale**, Cuv.)—

Differ from the Shrews by having [like the Solenodon] two very small teeth placed between the two large inferior incisors, and in their upper incisors, which are flattened and triangular. Behind these incisors are six or seven small teeth, and four bristled molars. Their muzzle is elongated into a small, very flexible proboscis, which is constantly in motion. Their long tail, scaly and flattened at the sides, and their feet with five toes all connected by membrane, proclaim them to be aquatic animals. Their eyes are very small, [the fur long, straight, and divergent,] and they have no external ears.

The Russian Desman (*Sorex moschatus*, Lin).—Nearly equal in size to the common Urchin; blackish above, inclining to white beneath; the tail one fourth shorter than the body. It is very common along the rivers and lakes of Southern Russia, where it feeds on worms, the larvæ of insects, and particularly on Leeches, which it easily withdraws from the mud by means of its flexible proboscis. Its burrow, excavated in a bank, commences under water, and ascends to above the level of the highest floods. This animal never comes voluntarily on shore, but is taken very often in the nets of the fishermen. Its musky odour arises from a kind of pomatum secreted in small follicles under the tail, and is even communicated to the flesh of Pike which devour the Desman.

There is found in the streamlets of the Pyrenees a smaller species of this genus, which has the tail longer than its body (*Myg. pyrenaica*, H.) [This constitutes the division *Mygalina* of Isidore Geoffroy.

The rest of the *Insectivora* have amazingly powerful fore-feet, designed for tearing open the ground, rather than for burrowing by merely scratching away the mould, as in the preceding genera.]

THE CHRYSOCHLORES (*Chrysocloris*, Lacepede),—

Like the preceding genus, possess two incisors above and four below; but their grinders are elevated, distinct, and nearly all in the form of triangular prisms: the muzzle is short, broad, and recurved; and their fore-feet have only three nails, of which the exterior is very large, much arcuated, and pointed, forming a powerful instrument for digging and burrowing into the soil; the others successively decrease in size. Their hind limbs have five toes of the ordinary dimensions. They are subterraneous animals, whose mode of life is similar to that of the Moles. To enable them to dig the better, their fore-arm is supported by a third bone placed under the cubitus.

The Cape Chrysochlore (*Talpa asiatica*, Lin. [now better known as *C. capensis*, Desm.)].—Rather smaller than our Moles, without apparent tail. It is the only known quadruped which presents any appearance of those splendid metallic reflections which adorn so many birds, fishes, and insects. Its fur is of a green, changing to copper or bronze: the ears have no conch, and the eyes are not perceptible.† It inhabits Africa, and not Siberia, as falsely reported. [There are three others, *C. Hottentota*, *Damarensis*, and *villosa*, all from the same general locality.]

THE MOLES (*Talpa*, Lin.)—

Are well known for their subterraneous life, and for their structure eminently qualified in adaptation to it. A very short arm, attached to a large shoulder-blade, supported by a stout clavicle, and provided with enormous muscles, sustains an extremely large hand, the palm of which is always directed either outwards or backwards: the lower edge of this hand is trenchant, and the fingers scarcely perceptible, but the nails which terminate them are long, flat, strong, and sharp. Such is the instrument which the Mole employs to tear open the ground, and throw back the mould behind it. Its sternum possesses, in common with that of Birds and Bats, a ridge which allows the pectoral muscles to attain the magnitude requisite for the performance of their functions. To pierce and raise up the ground, it makes

* This name being preoccupied by a genus of Spiders, Fischer has altered it to Myogalea.—ED.

† The Red Mole of America, Seba I. pl. xxxii. fig. 1, (Talpa rubra, Lin.), is most probably a Cape Chrysochlore, figured from a dried specimen, for then the fur appears purple. [It is more likely the Scalops canadensis.] But the Tucan of Fernandez, regarded as one of its synonymes, appears rather, to judge from its two long teeth to each jaw, and vegetable regimen, to be some subterraneous rodent, perhaps a Diplostoma.

use of its long, pointed head, the extremity of its muzzle being provided with a peculiar little bone, and the cervical muscles being extremely powerful. There is even an additional bone in the cervical ligament. The hinder part of the body is feeble, and the animal above ground advances as awkwardly as it does rapidly below the surface. Its sense of hearing is extremely acute, and the tympanum very large, although there is no external ear; but the eyes are so small, and so hidden beneath the hair, that their existence even was denied for a long while. [They have been ascertained, however, to be tolerably sharp-sighted.] The genital organs have this peculiarity, that the bones of the pubis do not become joined; by reason of which, notwithstanding the narrowness of the pelvis, they are enabled to produce tolerably large young ones: the urethra of the female passes through the clitoris: she has six teats. The jaws are feeble, and the food consists of insects, worms, and some tender roots, [chiefly, however, worms, though even small birds are sometimes sacrificed to their voracity, when they can dart upon them from the entrance of their runs]. There are six incisors above and eight below.* The canines have two roots, in which respect they partake of the nature of false molars †: behind them are four false molars above, and three below; and finally, three bristled molars. [The fur is set vertically in the skin, whence it has no grain or particular direction.]

Our common European Mole (*T. Europæa*, Lin.)—Entirely black, but often varying to white, fulvous, or pied. [A most remarkable animal, not only for the ardour of its passions, appetites, and emotions, but for the curious instincts with which it is endowed, more particularly with regard to the complicated regularity of its subterraneous dwelling and galleries.] According to M. Harlan, this species likewise exists in North America [or, at any rate, there is a species stated to be from that continent most closely allied to it, of which the Zoological Society of London possess specimens.]

M. Savi has found a Mole in the Apennines said to be quite blind, although otherwise similar to the common one (the *T. cæca*, Sav.): it is not, however, perfectly blind, for the eyelids have an opening, though smaller than in the common Mole. The existence of the optic nerve in this last species has been denied: I think I can demonstrate it throughout its course. [Two other species are known, *T. japonica* and *T. moogura*.]

THE CONDYLURES (*Condylura*, Illig.),—

Seem to combine the two kinds of dentition of the *Insectivora*: their upper jaw has two large triangular incisors, two others which are extremely small and slender, and upon each side a strong canine; the lower jaw has four incisors slanting forward, and a pointed canine of small size. Their superior false molars are triangular, and separated; the lower dentelated and trenchant. In their feet and whole exterior, the animals of this genus resemble the Moles, but have a longer tail, and, what very readily distinguishes them, their nostrils are encircled with small moveable cartilaginous points, which, when they separate, radiate like a star.

[Three or four species are now known, all from North America. Among them is] *Sorex cristatus*, Lin.

THE SHREW-MOLES (*Scalops*, Cuv.)—

Have teeth rather similar to those of the Desmans, except that their small or false molars are less numerous; the muzzle is simply pointed, as in the Shrews; and their hands are widened, armed with strong nails, and in short adapted for digging into the ground precisely as in the Moles, which they entirely resemble in their mode of life. Their eyes are equally small, and their ears concealed in the same manner.

Sorex aquaticus, Lin.—Appears to inhabit a very great part of North America, along the rivers: externally, it so nearly resembles the European Mole as to be readily mistaken for it. [Three other species, from the same general locality, have been recently discovered.

The INSECTIVORA, according to the views of De Blainville, should constitute an entirely distinct order, intermediate to the *Cheiroptera* and *Edentata*.

They present an almost unbroken series of successively distinct divisions, more or less allied together. The most definite super-generic section is that composed of the four genera last in order, or the various animals analogous to the European Mole. At the other end of the series, the spinous genera, at first sight, appear equally separated; but they certainly grade through *Centenes* and then *Gymnura* to the Shrews, which are again related to the *Talpidæ*; if, indeed, the line of separation should not be drawn between *Centenes*, and *Erinaceus* and *Echinops*: the

* Were this truly the case, it would be an anomaly throughout placental Mammalia: but as the lower canines, as thus assigned, close within the upper, we are led to identify the exterior pair of seeming incisors as the real canines.—ED.

† There is no essential difference between canines and false molars. See p. 65.—ED.

different generic groups, however, maintain their integrity. *Macroscelides* and *Tupaia* are the least conformable with the others; but neither are these much removed in their more essential characters. As a whole, they compose a very natural and appreciable division, and our author assigns them a rank equivalent to the CHEIROPTERA on the one hand, and to the CARNIVORA, comprising his *Plantigrada, Digitigrada*, and *Amphibia*, on the other.

Remains of three species of *Sorex*, one of *Talpa*, and one of *Erinaceus*, have been found in the European Tertiary deposits, apparently referable to species still in existence. The present range of the division does not extend to South America* nor Australia, where, however, it appears to be adequately represented by the numerous small *Marsupiata*, peculiar to those regions; a curious fact, first noticed by Waterhouse, and since by De Blainville.]

THE THIRD FAMILY OF CARNARIA.

CARNIVORA.

Although the designation *carnivorous* is applicable to all unguiculated Mammalia, except the *Quadrumana*, which have three sorts of teeth, inasmuch as they all subsist more or less on animal matter, there are nevertheless many, more especially of the two preceding families, which are reduced by the feebleness and the conical tubercles of their grinders to prey almost entirely on insects. In the present family, the sanguinary appetite is combined with the force necessary for its gratification. There are always four stout and long separated canines, between which are six incisors to each jaw, of which the second inferior are inserted a little more inward than the rest. The molars are either wholly cutting, or have some blunted tuberculous parts, but they are never studded with sharp conical projections.

These animals are the more exclusively carnivorous, in proportion as their teeth are more completely trenchant or cutting, so that the degree of admixture of their regimen may be almost calculated from the extent of the tuberculous surface of their teeth, as compared with the cutting portion. The Bears, which can live altogether on vegetables, have nearly all their teeth tuberculated.

The anterior molars are the most trenchant; next follows a molar, larger than the others, which has usually a tuberculous projection, differing in size; and then follow one or two smaller teeth, that are entirely flat. It is with these small hindward teeth that the Dog chews the herbage that he sometimes swallows. We will call, with M. F. Cuvier, this large upper molar, and its corresponding one below, *carnivorous teeth;* the anterior pointed ones, *false molars*, and the posterior blunt ones, *tuberculous molars.*

It is easy to conceive that the genera which have fewer false molars, and of which the jaws are shorter, are consequently better adapted for biting.

Upon these differences the genera can be most surely established.

The consideration of the hind-foot, however, must also be attended to.

Several genera, like those of the two preceding families, in walking, place the whole sole of the foot on the ground, a circumstance [generally] indicated by the absence of hair on all that part.†

Others, and by far the greater number, rest on only the ends of the toes, elevating the tarse. Their gait is more rapid, and to this primary difference are added many others of habit, and even of internal conformation. In both, the clavicle is a mere bony rudiment suspended in the muscles.

THE PLANTIGRADA

Constitute this first tribe, which walk on the whole sole of the foot, a circumstance which gives them greater facility of standing upright upon their hind-feet. They partake of the slowness

* *Sorex tristriatus* of some of the old authors is a true *Didelphis*. —ED.

† In the Polar Bear, and Panda, the sole is completely covered with hair: the same is observable in some Martens; while others of this genus have the sole altogether naked.—ED.

and nocturnal life of the *Insectivora*, and, like them, have no cœcum : most of those which inhabit cold countries pass the winter in a state of lethargy. All have five toes to each foot.

THE BEARS (*Ursus*, Lin.)—

Possess three large molars on each side of both jaws*, altogether tuberculous, and of which the posterior above are the most extended. These are preceded by a tooth a little more trenchant, which is the carnivorous tooth of this genus†, and by a variable number of very small false molars, which sometimes fall at an early age. This system of dentition, almost frugivorous, explains why, notwithstanding their great strength, the animals of this genus devour flesh only from necessity.

They are large stout-bodied animals, with thick limbs, and tail extremely short : the cartilage of their nose is elongated and moveable. They excavate dens and construct huts [?], where they pass the winter in a state of somnolency more or less profound, and without taking food. It is in these retreats that the female brings forth.

The species are not easily distinguished by obvious characters.

The Brown Bear (*U. arctos*, Lin.) of Europe, has the forehead convex : fur, brown, more or less woolly when young, becoming smoother with age. It varies, however, considerably in colour, and also in the relative proportion of parts : the young have generally a pale collar, which in some is permanent. This animal inhabits the high mountains and extensive forests of Europe, together with a great part of Asia. [The Barren-ground Bear of North America appears to be undistinguishable.] It couples in June, and brings forth in January; nestles sometimes very high up in trees; its flesh is good eating when young, and the paws are much esteemed at all ages. [The Black Bear of Europe is now generally regarded as a mere variety.]

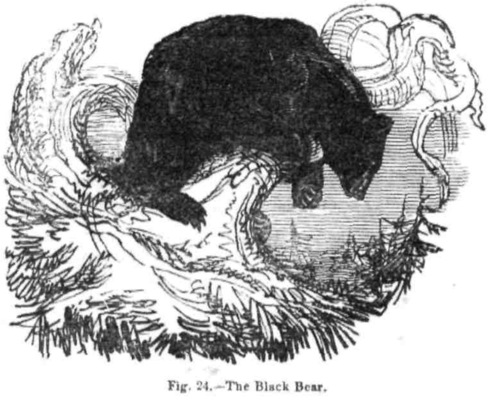

Fig. 24.—The Black Bear.

The Black Bear (*U. americanus*, Gm.) of North America, is a species well distinguished, with a flat forehead, smooth and black fur, and fulvous muzzle. We have always found the small teeth behind its canines to be more numerous than in the Bear of Europe. It lives chiefly on wild fruits, and where fish is abundant sometimes frequents the shores for the purpose of catching it; resorts to flesh only in default of other food, [and is then destructive to Pigs ; is a great devourer of honey, in common with most others of the genus] : its flesh is highly esteemed. There is another Black Bear found in the Cordilleras, with white throat and muzzle, and large fulvous eye-brows (*U. ornatus*, F. Cuv.), [considered by many to be a variety of *U. americanus*. The *Jardin des Plantes*, however, has lately received a Bear from the Peruvian Andes, which appears very distinct : colour of *U. arctos*, with larger ears.

The gigantic Grisly Bear (*U. ferox*), now a well-known species, from the Rocky Mountains of North America, is the most formidable of all the land Bears, and by much the largest. It can only ascend trees, as the others do, when young. It constitutes the ill-characterized subgenus *Danis* of Gray.

The Syrian Bear (*U. syriacus*) is of a fulvous white colour, with a stiff mane of close erected hairs between the shoulders. The species which inhabits the Atlas chain of mountains remains to be ascertained.]

The East Indies produce several Bears of a black colour; such as

The Malayan Bear (*U. malayanus*); from the peninsula beyond the Ganges to the islands of the Straits of Sunda. —Sleek [with comparatively short fur], a fulvous muzzle, and heart-shaped mark of the same colour upon the chest. [This, and another species, or perhaps variety, (*U. euryspilus*,) with the whole chest fulvous, from Borneo, constitute the division *Helarctos* of Horsfield, or the *Sun Bears*. They are small, and of very gentle and playful disposition, easily rendered quite tame.] It is very injurious to the cocoa-nut trees, which it climbs in order to devour the tops, and drink the milk of the fruit.

The Thibet Bear (*U. thibeticus*, F. Cuv.)—Black ; the under lip, and a large mark in the form of a Y on the breast, white ; profile straight and claws weak. [Is intermediate to the preceding and next species.] From the mountains in the north of India.

The most remarkable, however, of all these Indian Bears is the following, of which Illiger forms his genus *Prochilus*.

* We shall no longer repeat the words *on each side*, &c. ; it being understood that where the molars of one side are spoken of, those of the other correspond.

† Although it may seem presumptuous to attempt to set Cuvier right in matters of this kind, it is nevertheless sufficiently obvious, on analogical comparison of the Bear's dentition with that of proximate genera, that the third tooth in succession from behind represents the cutting or carnivorous tooth in each jaw, there being two tuberculous grinders in this and the five succeeding genera (which together compose a distinct natural group), and one only in the remainder.—ED.

The Jungle Bear (*U. labiatus*, Blainv.: *U. longirostris*, Tied: *Bradypus ursinus*, Shaw), which has the nasal cartilage dilated, and the tip of the under lip elongated, both lips being moveable: when old, very long shaggy hairs surround the head. The muzzle and tips of the paws are fulvous or whitish, and there is a half-collar or Y-like marking on the fore-neck and cheek. [The incisors of this species generally drop at an early age.] It is a favourite with the Indian jugglers on account of its uncouth appearance.

Fig. 25.—The Jungle Bear.

M. Horsfield describes another Bear from Nipâl of a light bay colour, the nails of which are less trenchant than those of the other Bears of India, and which appears to him a distinct species. We have also recovered many fossil bones of lost species of Bears; the most remarkable of which are *U. spelæus*, Blumenb., with a rounded forehead, and of very large size; and *U. cultridens*, Cuv., for which see the fourth vol. of my *Ossemens Fossiles:* [another extinct species (*U. sivalensis*, Caut. and Falc.), has been detected in the Sivalik deposits of the sub-Himmalayas.] Lastly,

The Polar Bear (*Ursus maritimus*, Lin.), is yet another species, very distinctly characterized by its lengthened and flat head, and by its smooth and white fur. It pursues Seals and other marine animals [on the polar ice, but in captivity will thrive, like the rest, on vegetable food only. It is the largest of the genus,] and exaggerated reports of its voracity have rendered it very celebrated. [It constitutes the *Thalarctos* of Gray.]

THE RACCOONS (*Procyon*, Storr.)—

Have three tuberculous back molars [the first representing the carnivorous tooth], of which the superior are nearly square, and three pointed false molars before them, forming a continuous series to the canines, which are straight and compressed. Their tail is [moderately] long; but the rest of their exterior is that of a Bear in miniature. They rest the whole sole of their foot on the ground only when they are still, raising the heel when they advance. [Are peculiar to the western continent.]

The Common Raccoon (*Ursus lotor*, Lin.; *Mapach* of the Mexicans.)—Greyish brown; the muzzle white; a brown streak across the eyes: tail annulated with brown and white rings. An animal the size of a Badger, which is easily tamed, and remarkable for a singular instinct of eating nothing that it has not previously dipped in water. It is a native of North America, and subsists on eggs, birds, &c.

The Crab-eating Raccoon (*P. cancrivorus*, Buff. Supp. vi. xxxii.)—Uniform ash-brown; the caudal rings less distinct. From South America. [Three others have been described by Prof. Wiegmann, (see *Ann. Nat. Hist.* i. 133), of which *P. Hernandrii*, Wagler, would appear to be dubiously separable from *P. lotor*.]

THE PANDA (*Ailurus*, F. Cuv.)—

Appears to approximate the Raccoons by its canines and what is known of its other teeth; except that it has only one false molar. "Gen. Hardwicke has since described it to have four square tuberculous molars, and one trenchant false molar in front, at a short distance from the canine." The head is short; tail [rather] long; gait plantigrade, the toes five in number, with half-retractile nails.

Only one is known, the Bright Panda (*A. refulgens*, F. Cuv.)—Size of a large Cat; the fur soft and thickly set: above of the richest cinnamon-red; behind more fulvous, and deep black beneath. The head is whitish, and the tail annulated with brown. This beautiful species, one of the handsomest of known quadrupeds, from the mountains of the north of India, was sent to Europe by my late son-in-law, M. Alfred du Vaucel. [It frequents the vicinity of rivers and mountain torrents, passes much of its time upon trees, and feeds on birds and the smaller quadrupeds. Is generally discovered by means of its loud cry or call, which resembles the sound *wha*, often repeated. The soles of its feet are hairy.]

Fig. 22.—Ailurus fulgens.

THE BINTURONGS (*Ictides*, Valenc.; *Arctictis*, Tem.)

Are also related to the Raccoons by their dentition; but the three superior back molars are considerably smaller, and less tuberculous, the last one of each jaw more particularly, which is very small and almost simple. These animals are

covered with long hair, and have a tuft at each ear. The tail is long, hairy, and has a propensity to curl, as if prehensile; [which it really is: their whiskers are long and conspicuous].

They are also natives of India, for the first knowledge of which we are indebted to M. du Vaucel. One species (*Ict. albifrons*, F. Cuv.) is grey, with the tail and sides of the muzzle black; of the size of a large Cat; from Boutan. Another (*Ict. ater*, F. Cuv.) is black, with a whitish muzzle, and as large as a stout Dog; from Malacca. [The latter is merely the male, and the other the female of the same species, which is rather a slow-moving animal, allied to the last in habit, of a timid disposition, and easily tamed. The *Ictide dorée*, F. Cuv., is a species of Musang (*Paradoxurus*).]

THE COATIMONDIS (*Nasua*, Storr),—

To the dentition, tail [which however is longer], nocturnal life, and slow dragging gait of the Raccoons, add a singularly elongated and moveable snout. Their feet are semi-palmate, notwithstanding which they climb trees [with great facility, and descend them head foremost, clinging by their hind feet, which they almost reverse]. Their long claws serve them to dig with; [and they feed voraciously on earth-worms, slugs and snails, also on small mammalians (which they catch adroitly), birds and their eggs, together with fruits and vegetables]. They inhabit the warm parts of America, and subsist on nearly the same food as our Martens.

The Red Coatimondi (*Viverra nasua*, Lin.; *N. rufa*, Desm.)—Rufo-fulvous, the muzzle and caudal annulations brown. And the Brown Coatimondi (*V. narica*, Lin.; *N. fusca*, Desm.)—Brown, with white spots over the eye and snout. [These animals employ their claws to divide flesh, which they thus tear and separate before devouring it.]

THE KINKAJOU (*Cercoleptes*, Illiger)—

Can scarcely be introduced elsewhere than in this place [which is unquestionably its true position]. To the plantigrade gait, it joins a very long tail, prehensile, as in the Sapajous*, a short muzzle, slender and extensile tongue, with two pointed grinders before, and three tuberculous ones backward, [the first of which latter represents the carnivorous tooth].

But one species is known (*Viverra caudivolvula*, Gm.), from the warm parts of America and some of the Great Antilles, where it is named *Potto*†: size of a Fitchet, [and larger]; the fur woolly, and of a yellowish [or golden] brown: nocturnal, and of a mild and gentle disposition; subsisting on fruits, honey, milk, blood, &c. [It is eminently an arboreal quadruped, which moves with a cautious gait, recalling to mind some of the *Quadrumana*.

There is a Mexican animal to which Lichtenstein has assigned the generic name *Bassaris*, and which Blainville and others have associated with the Viverrine genera, but which I greatly suspect must rather be placed near the Kinkajou, though I have not at present the means of ascertaining its characters. In form it is not unlike a Musang (*Paradoxurus*.) ‡

The remaining genera are only semi-plantigrade (that is, they do not bring the heel quite to the ground), and possess but one tuberculous grinder, which varies greatly in extent of surface: none of them become torpid in winter; and they all emit, when alarmed, a defensive odour, which in many is horribly fetid.]

THE BADGERS (*Meles*, Storr),§—

Which Linnæus placed, together with the Raccoons, in his genus of Bears, have one very small tooth behind the canine, then two pointed molars, followed in the upper jaw by one which we begin to recognize as carnivorous, from the trace of a cutting character which it exhibits on its outer side; behind this is a square tuberculous tooth, the largest of the series; and, on the lower jaw, the last but one likewise commences to bear some resemblance to the inferior carnivorous tooth; but as there are two tubercles on its inward border as elevated as its cutting point, it performs the office of a tuberculous one; the last below is very small. [The Badger, in fact, has precisely the same dentition as the Weasels and Otters, presenting a modification of that type for less carnivorous regimen.]

These animals have the tardy gait and nocturnal habit of all the preceding; their tail is short, [and

* One which I had an opportunity of studying, as it ran about loose in a room, possessed the prehensile power of the tail in an extremely moderate degree, merely resting slightly on this organ, which it stiffened throughout its length, and never coiled in the manner of the Sapajous.—ED.

† This term, applied by the negroes in Africa to a Lemurine animal (*Perodicticus*), has been introduced by them, and misapplied in other countries.—ED.

‡ Strong presumptive evidence that the Basset (*Bassaris*) does not appertain to the Viverrine group, is afforded by the restriction of the geographic range of the latter to the eastern hemisphere, in every other instance. The presence or absence of a cæcum would decide the question.

§ *Taxus* of some systematists: but this name is employed in Botany for the Yew genus.—ED.

commonly held erect]. Their toes are much enveloped in the skin ; and, what eminently distinguishes them, is a pouch situate beneath the tail, from which exudes a fatty, fetid humour, [as in the Skunks, Weasels, &c., to which the Badgers are very closely allied]. The long claws of their *fore-feet* enable them to burrow with much facility.

Fig. 25.—Common Badger.

The European Badger (*Ursus meles*, Li .; *M. taxus*, Auct.)—Greyish above, beneath black, with a dusky band on each side of the head. That of America (*Mel. hudsonius* [(?) *M. labradorius*, Sabine; *Ursus taxus*, Schreb.] does not appear to differ essentially. [It is even generically very distinct, pertaining to the next division. A second species of Badger, however, appears to me to exist in the *Balysaur* of India (*Arctonyx collaris*, F. Cuv.; *Mydaus collaris*, Gray,) which M. F. Cuvier has represented much too Hog-like in his figure; the snout being scarcely longer than that of the European Badger, the fur somewhat coarser, and the tail (which almost reaches the ground) not so scantily covered with hair as stated.* A cranium figured as that of the Balysaur by Mr. Gray, in his published series of Gen. Hardwicke's drawings, appears to me to indicate another species, distinguished by the long vacant interspace between the inferior canine and first existing molar. This genus would seem to be peculiar to the eastern continent.

THE TAXELS (*Taxidea*, Waterh.)—

Are the reputed Badgers of America, but which present a very different cranium, and more carnivorous dentition: their cutting molar is increased, and the tubercular reduced, to an equal size; the latter having a triangular crown: skull widest at the occiput, where it is abruptly truncated; the auditory bullæ much developed; and articulating surface of the lower jaw extended, but not locking as in the Badgers. Their claws are longer and stouter, enabling them to burrow with great rapidity.

Fig. 26.—Taxel.

One only is clearly ascertained, the *T. labradoria* (*Ursus taxus*, Schreb.) Remarkable for the fine quality of its fur. Dr. Richardson has taken a Marmot from the stomach of this animal.

THE BHARSIAH (*Ursotaxus*, Hodgson).

Four cheek-teeth above and below, comprising two superior and three inferior false molars; the tubercular of the upper jaw transverse, and smaller than the carnivorous tooth. General conformation similar to that of the Badger, but without external ears.

But one species is known (*N. inauritus*, Hodg., *Asiat. Res.* xix. 60, and *Journ. As. Soc.* v. 621), from the vicinity of Nipâl, scantily covered with coarse hair. It is completely plantigrade and fossorial, dwelling in burrows on the southern slopes of the hills, which it seldom leaves during the day.]

THE WOLVERINES (*Gulo*, Storr)—

Have also been placed in the Bear genus by Linnæus; but they rather approximate the Martens in their dentition and general character, according only with the Bears in their plantigrade gait. They have three false molars above, and four below, anterior to the carnivorous tooth, which is well characterized; and behind this a small tubercular, which is wider than long. Their upper carnivorous tooth has but one small internal tubercle, so that they have nearly the same dental system as the

* There is a figure, in Bewick's *Quadrupeds*, apparently of this species, taken from a seemingly unhealthy individual confined in the Tower Menagerie. The description intimates its near resemblance to the common Badger.

Martens. These animals have the tail of middle length, with a fold beneath it in place of a pouch; and their foot is very similar to that of a Badger.

The most celebrated species is the *Glutton* of the north, *Rossomak* of the Russians (*Ursus gulo*, Lin.); size of a Badger, and commonly of a fine deep maroon colour, with a browner disk on the back; but sometimes it is paler. It inhabits the glacial regions of the north, is reputed to be very sanguinary and ferocious, hunts by night, does not become torpid during the winter, and subdues the largest animals by leaping upon them from a tree. Its voracity has been absurdly exaggerated by some authors. The Wolverine of North America (*Ursus luscus*, Lin.) does not appear to differ by any constant characters, but is generally of a paler tint. [Excepting in size and massiveness, I cannot perceive that this animal differs from the Martens: assuredly it does not in the structure of its feet.]

Warm climates produce some species which can only be placed near the Wolverines, from which they differ merely in having one false molar less to each jaw, and by a longer tail. Such are the animals termed by the Spanish inhabitants of North America Ferrets (*Hurons*), and which in point in fact have the dentition of our Ferrets and Weasels, and lead the same kind of life; but they are distinguished by their semi-plantigrade carriage, [or rather by having their soles uncovered with hair]. Such are

The Grison (*Viverra vittata*, Lin.)—Black, the top of the head and neck grey, a white band reaching from the forehead to the shoulders. [This constitutes the *Grisonia*, Gray, and with an allied species, *le petit furet* of Azzara (*Galictis Allamandi*, Bell), the *Galictis** of the last-named naturalist, who places them contiguous to the Weasels. They are small animals, easily rendered very tame, and extremely playful in domestication; of very carnivorous disposition, and particularly fond of eggs.]

The Taira (*Mustela barbara*, Lin.) [Subdivision *Taira* of Gray.]—Brown [or brownish-black]; the head grey; [and sometimes] a large white spot under the throat. [The fur remarkably short.]

These two animals are distributed throughout the warm parts of America, and exhale an odour of musk. Their feet are a little palmated, and it appears that they have been sometimes taken for Otters.† [We conceive that the Wolverine might be advantageously removed to the genus of Martens; and would restrict the term *Gulo* to the others. The Grisons diffuse when irritated a disgusting stench.]

THE RATELS (*Mellivora*, F. Cuv.)—

Have a false molar to each jaw still less than the Grisons, and their upper tuberculous tooth but little developed, so that they approximate the Cats in dentition; but their whole exterior is that of the Grison, or [rather] of a Badger. The legs are short; feet [semi-]plantigrade, and five toes to each; the claws very strong, &c.

But one species is known (*Viverra mellivora*, Sparm., and *Viv. capensis*, Schreb. pl. 125), of the size of the European Badger; grey above, black below, with a white line that separates the two colours; sometimes it is almost wholly white above. It inhabits the Cape of Good Hope, and burrows into the ground with its long claws, in search of the honey-combs of the wild Bees.

THE DIGITIGRADA—

Form the second tribe of CARNIVORA, the members of which walk on the ends of their toes.

In the first subdivision of them [all the members of which are semi-plantigrade], there is only one tuberculous grinder behind the upper carnivorous tooth: these animals, on account of the length of their body, and shortness of the limbs, which permit them to pass through very small openings, are styled *vermiform* [*vermin*]. They are destitute of cœcum, like the preceding, but do not pass the winter in a state of lethargy. Although small and feeble, they are very sanguinary and ferocious. Linnæus comprehended them all under one genus, that of

THE WEASELS (*Mustela*, Lin.),—

Which we will divide into four subgenera.

THE TRUE WEASELS (*Putorius*, Cuv. [*Mustela*, Ray.])—

Are the most sanguinary of any: their lower carnivorous tooth has no internal tubercle, and the upper tuberculous one is broader than long; there are only two false molars above and three below. These animals may be recognized by having the extremity of the muzzle somewhat shorter and blunter than in the Martens. They all diffuse [when alarmed] a fetid stench; [take the water, and dive with facility, having the toes semipalmated; trace their prey by scent, and kill it by inflicting a wound in the neck: the female is commonly much smaller than the male.

* This must not be confounded with the *Galictis* of Is. Geoffroy (*Compte rendu*, Oct. 1837), which refers to the *Mustela* or *Putorius striatus* of Cuvier.—ED.

† It is supposed from the description given by Marcgreave of his *Cariqueibeia*, which name Buffon has applied to his *Saricovienne*, vol. xiii. p. 319, that he meant to speak of the Taira.

There are very many species, three of which inhabit Britain:—The Fitchet Weasel, or *Polecat*, of which the Ferret appears to be a domesticated variety*; the Stoat, or Ermine, which in cold countries (and occasionally even in South Britain) becomes pure white in winter, except the end of its tail, which always continues black; and the Common Weasel, of diminutive size, which preys chiefly on Mice and other small animals injurious to the agriculturist. It is a curious fact that in several instances the female Polecat has been known to stow away many Frogs and Toads in an apartment of its burrow, disabling each without killing it, by puncturing the skull. The Common Weasel traverses the boughs of trees, tops of palings, &c., with facility, and will spring from the ground upon a Partridge flying near the surface. *Put. striatus*, Cuv., a small Madagascar species, reddish-brown, with five longitudinal white stripes, composes the division *Galictis* of Isidore Geoffroy (not of Bell); and *Put. Zorilla*, Cuv., a species marked with broken stripes of white, and possessing a more snout-like muzzle, the tail of which also is longer and more bushy, is the *Zorilla capensis* of some recent authors: there would appear, indeed, to be several species of these Zorilles.]

THE MARTENS (*Mustela*, Cuv. [*Martes*, Ray])—

Differ from the true Weasels by having [commonly] an additional false molar above and below, and a small tubercle on the inner side of their carnivorous tooth; two characters which somewhat diminish the ferocity of their nature. [They are handsome, and remarkably lithe active animals, with larger ears than the Weasels, and fine bushy tails; are also more arboreal in their habits. The scent they diffuse when irritated is not disagreeable.†]

Fig. 27.—The Marten.

There are two species in Europe, very closely allied together. The Yellow-breasted or Pine Marten (*Mustela martes*, Lin.), inhabiting wild districts, and the White-breasted or Beech Marten (*M. foina*, Lin.), which frequents woods near human habitations. [Many consider these to be varieties merely of the same; but on examining several crania, I have noticed that the former are constantly smaller, with the zygomatic arch fully twice as strong as in the other. The American species usually deemed identical with *M. foina*, is intermediate. There are numerous others, as the Pekan or Fishing Marten of Canada, &c.; and the Sable of commerce (*M. zibellina*, Auct.), celebrated for its beautiful fur, is a member of this division. In the Sable and several others, the soles are completely covered with close fur; but in *M. flavigula* of the Himmalayas, the under surface of the foot is naked, and the toes joined to their extremities, as in the Badgers, &c.]

THE SKUNKS (*Mephitis*, Cuv.)—

Possess, like the Weasels, two false molars above and three below; but their superior tuberculous grinder is very large, and as long as broad, and their inferior carnivorous tooth has two tubercles on its inner side, thus approximating these animals to the Badgers, in the same way as the Weasels are related to the Grisons and Wolverine. In addition to this, the Skunks accord with the Badgers in having their anterior claws long, and adapted for burrowing, and they are even semiplantigrade, [and equally slow in their movements]. This resemblance extends even to the distribution of their colours. [The truth is, they scarcely differ from the Badgers, except in having a remarkably fine and large bushy tail, which is borne elevated, like the small short tail of the Badgers.] In the present family, notorious for diffusing a fetid stench, the Skunks are pre-eminently distinguished by emitting a most intolerable odour.

These animals are mostly striped longitudinally with white on a black ground, but the number of stripes appears to vary even in the same species; [not, however, I think, to the extent that has been supposed; for there are several species, distinguishable by their osteology, which agree sufficiently in their general style of colouring, allowing for some variation on the part of each, to induce the supposition, judging only from external characters, that they might all be referred to one. The intensity of their most nauseous suffocating stench, which has been described to resemble that of the Fitchet mingled with assafœtida, is scarcely credible: it appears, however, to be emitted only in self-defence. The geographic range of this genus is confined to America].

We may make an additional subgenus of

THE TELEDU (*Mydaus*, F. Cuv.),—

Which, together with the dentition, [the teeth, however, being smaller (from which results a more

* I have sought in vain for any osteological distinction between these animals.—ED.

† Hence our native species are designated *Sweet-mart*, in opposition to *Fou-mart*, or *foul mart*, a common name for the Polecat.—ED.

elongated muzzle), the canines placed further backward, and the molars more sharply tuberculated, recalling to mind those of the *Insectivora*], feet, and colouring even of the Skunks, have the muzzle truncated, so as to assume the form of a snout, and the tail reduced to a small pencil, [which, however, is also held erect, as in the Badgers, &c.] Only one species is known,—

The Javanese Teledu (*Mid. melaceps*, F. Cuv.)—[Brownish] black, the nape of the neck, a stripe along the back, and tail, white; the dorsal stripe sometimes interrupted about the middle. [Fur soft and rather fine.] Its stench is equally horrible with that of the Skunks, [and precisely similar, as I am informed by Dr. Horsfield, who has had experience of both: it subsists principally on earth-worms, for which it turns up the light soil with its snout, in the manner of a Hog; is easily tamed, and by no means offensive in captivity; and it is especially remarkable for its restriction to a particular elevation on the mountains of Java, below which it is never found.

We may here also introduce

THE NYENTEK (*Helictis*, Gray; *Melogale*, Is. Geof.),—

The body of which appears to be more lengthened and vermiform, and the tuberculous molar small and transverse: it is described to have three false molars above, and four below; the upper carnivorous tooth three-lobed, with a broad two-pointed internal process: soles of the feet bare, and toes united.

The Nyentek of the Javanese (*Gulo orientalis*, Horsf.; *H. moschatus*, Gray.)—Size of a Polecat: brown, with a white stripe along the back, crossed by another less distinct over the shoulders, and a white spot on the head; tail of mean length. This animal inhabits eastern Asia, and smells strongly of musk: it is one of the few Mammalia known in Europe to inhabit China, where the larger indigenous species are supposed to have been exterminated.]

THE OTTERS (*Lutra*, Storr)—

Have three false molars above and below, a strong process to the upper carnivorous tooth, an internal tubercle to the lower one, and a large tuberculous grinder that is nearly as long as broad; their head is flattened, and the tongue rather rough. They are distinguished from all the preceding genera by their [more completely] webbed toes, and horizontally flattened tail,—two characters which proclaim them to be aquatic animals: they subsist on fish.

The European Otter (*Must. lutra*, Lin.)—Brown above, whitish round the lips, on the cheeks, and the whole under parts. The rivers of Europe [and sometimes the sea-coast. Is occasionally spotted above with white. The species of this extensive genus, which is almost generally diffused, are mostly very similar externally, and are best distinguished by the configuration of the cranium, &c.] That of India (*L. nair*, F. Cuv.) is employed for fishing, as the Dog is for hunting. The Cape Otter (*L. capensis*, F. Cuv.) is remarkable (at least at a particular age) for having no nails; a character on which M. Lesson has founded his genus *Aonyx*: young individuals, however, have been received from the Cape, which possess nails; and it remains to ascertain whether they are of the same species. The American Otter (*M. braziliensis*), from the rivers of both Americas, has the extremity of the muzzle, which in most other animals is naked, covered with close fur: [it is also very gregarious in its habits. But the most remarkable species is the great Sea Otter (*Mustela lutris*, Lin., composing the division *Enhydra* of Fleming. It is twice the size of the European species, from which it differs in the form of its hind feet, which have the outermost toe longest. The adults have but four lower incisors, the exterior pair being doubtless forced out by the canines.] Its blackish velvet-looking fur is extremely valuable, to obtain which the English and Russians hunt the animal throughout the northern shores of the Pacific Ocean, for the purpose of disposing of it to the Chinese and Japanese. [A species intermediate to the Sea Otter and the others constitutes the *Pteronura*, Gray. M. Temminck has received a new genus allied to the Otters, which he names *Potamophilus*.

We here arrive at the termination of an extensive and very distinct natural group, which falls under two principal subdivisions, the limits of which, however, are not easy to define.

The first consists of exclusively ground animals, with a thick and heavy body, stout limbs, and strong claws adapted for burrowing with rapidity. It comprises the Badgers, Teledu, Skunks, Taxels, Bharsiah, and Ratel; nearly all of which ordinarily erect the tail, and are more or less striped longitudinally.

The remainder are vermiform and agile, and most of them ascend trees with facility: they are also more predatory, though some of the former (as the Ratel) possess an equally carnivorous dentition: many are marked similarly to the preceding.

The Zorilles might almost be referred to either section; but we prefer retaining them near the Weasels.]

The second subdivision of the DIGITIGRADA [being the first, strictly so named,] possesses [like the *Ursidæ*] two flat tuberculated molars posterior to the upper carnivorous tooth*,

* There are three tuberculous molars to each jaw in the *Canis* (*Megalotis*) *Lalandi*, and De Blainville figures the cranium of a common Dog in which the same was observable.—ED.

which has itself a large internal process. They are carnivorous animals, but not predatory in proportion to their strength, and often feed on carrion. They have all a small cœcum.

THE DOGS (*Canis*, Lin.)—

Have three false molars above, four below, and two tuberculous grinders behind each carnivorous tooth. The first of these upper tuberculous molars is very large. Their superior carnivorous tooth has only a small internal tubercle; but the inferior one has its hinder portion altogether tuberculous. The tongue is soft; the fore-feet have five toes, and the hind-feet [in general] only four. [The cœcum is of a peculiar spiral form.]

The Domestic Dog (*C. familiaris*, Lin.)—Distinguished by its recurved tail, but otherwise varying infinitely with respect to size*, form, colour, and quality of the hair. It is the most complete, the most singular, and useful conquest ever made by Man; the whole species having become his property: each individual is devoted to its particular master, assumes his manners, knows and defends his property, and remains attached to him until death; and all this, neither from constraint nor want, but solely from gratitude and pure friendship. The swiftness, strength, and scent of the Dog have rendered him a powerful ally to Man against other animals, and were even, perhaps, necessary to the establishment of society. It is the only animal which has followed Man all over the world.

Some naturalists think the Dog is a Wolf, and others that he is a domesticated Jackal; but those which have become wild on desert islands resemble neither one nor the other.†

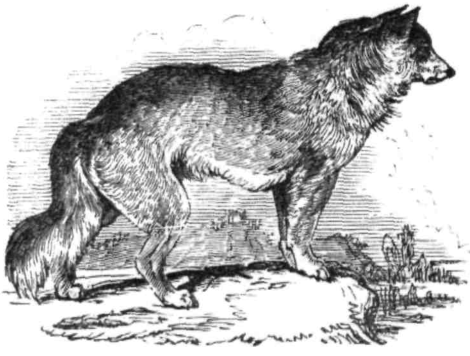

Fig. 28.—The Dingo, or Australian Dog.

The wild Dogs, and those which belong to savages, such as the inhabitants of Australia, have straight ears, whence has arisen a belief that the European races, nearest to the original type, are our *Shepherd's Dog* and *Wolf Dog*; but comparison of the crania indicates a closer approach on the part of the French *Mâtin* and *Danish Dog*, after which follow the *Hound*, the *Pointer*, and the *Terrier*, which chiefly differ in size and the relative proportions of parts. The *Greyhound* is more attenuated, and has the the frontal sinus smaller, and scent weaker. The *Shepherd's Dog* and *Wolf Dog* resume the straight ears of the wild ones, but with greater developement of brain, which continues to increase, together with the intelligence, in the *Barbet* and *Spaniel*. The *Bull-dog*, on the other hand, is remarkable for the shortness and strength of its jaws. The small pet Dogs, the *Pugs*, lesser *Spaniels*, *Shocks*, &c., are the most degenerate productions, and exhibit the most striking marks of that influence to which Man subjects all nature.

The Dog is born with its eyes closed; it opens them on the tenth or twelfth day; its teeth commence changing in the fourth month, and its full growth is attained at the expiration of the second year. The female remains with young sixty-three days, and produces from six to ten young at a birth. The Dog is old at fifteen years, and seldom

* A specimen, which attained two years of age, and is preserved in the Museum of Dresden, measured only five inches and a half in length; this being exactly the same length, from the corner of the eye to the tip of the nose, of a Saxon boar-hound examined by Col. Hamilton Smith.—ED.

† If the idea, which I conceive there is every reason to entertain, respecting the origin of the Domestic Dog be well founded, it is clear that a recurrence to a single wild type would be impossible. The Dog is apparently a blended race, derived principally from the Wolf, and partly from various other allied species. In the Museum of the Zoological Society of London, there is a specimen of an Esquimaux Dog, which resembles the large American Wolf (*C. nubilus*) so closely, that there can scarcely be any doubt of the connexion which subsists between them; and it is well known, of the American Wolves in particular, that if a young animal be surprised by a hunter, and suddenly menaced by his voice and manner, it will crouch to him and implore his mercy in precisely the manner of a spaniel; so that only a little encouragement and kindness are required to gain its permanent attachment; indeed, many of them are killed to obtain the proffered reward, by taking this (assuredly unworthy) advantage of their natural submissiveness. That the Wolf possesses the mental qualities, and is capable of the same strong attachment to Man as the most faithful Dog, has been abundantly proved by the observations of M. F. Cuvier and others; and the unremitting persecution to which it has been necessarily subjected in Europe for so many ages, will sufficiently account for the savage and distrustful character which it exhibits when unreclaimed; though even then the germs of a better disposition are traceable in the permanent attachment of the male and female, and sociality of the young till urgent necessity, or the annual period of dominant sexual excitement, subdues every milder propensity and acquired sentiment of friendship or disinterested affection.

In the late edition of Dr. Prichard's work on Man, an old error is revived, which originated with Buffon, but which that naturalist afterwards corrected; namely, that the period of gestation in the Wolf is much shorter than in the Dog. It is precisely the same in both animals.

Instances occasionally happen of the Dog returning by choice to a state of wildness, and assuming then, of necessity, the character ascribed to the Wolf. I have known this to occur in a male pointer, and in a female greyhound: the latter was so fine a specimen of the breed, that on being entrapped, it was thought desirable to obtain a litter from her, which was accordingly effected; but, while her puppies were very young, she managed to escape to the woods, and never returned: three of her progeny grew to be excellent hounds; but two others proved quite irreclaimable; and escaping from servitude, like their dam, were finally shot, for their destructive poaching propensities.

It is not unusual to trace the peculiar markings, and grizzled colouring of the back, common to most of the wild species of *Canis*, in domestic Dogs, of various size and character.—ED.

lives beyond twenty. Every one is acquainted with its vigilance, bark, singular mode of copulation, and susceptibility of various kinds of education.

The Wolf (*C. lupus*, Lin.)—A large species, with a straight tail; the most noxious of all the *Carnivora* of Europe. It is found from Egypt to Lapland, and appears to have passed over to America. Towards the north, its coat becomes white in winter. It attacks all our animals, but does not evince a courage proportioned to its strength; it often feeds on carrion. Its habits and physical developement are closely related to those of the Dog. Another species, the Black Wolf (*C. lycaon*) is sometimes, though rarely, found in France. The Mexican Wolf (*C. mexicanus*, Lin.) has the under part of the body and the feet white.

The Red Wolf (*C. jubata*, Az.)—A fine cinnamon red, with a short black mane along the spine. From the marshes of South America. [The beautiful fur of this animal renders it one of the handsomest of the genus.]

The Jackal (*C. aureus*, Lin.) [division *Vulpicanis*, Blainv. and *Jacalus*, Hodg.]—A voracious species, which hunts like the Dog [in packs], and in its conformation and the facility with which it is tamed, resembles the latter more nearly than any other wild species. Jackals are found from the Indies and the environs of the Caspian Sea, as far as Guinea inclusive; but it is doubtful whether they all belong to the same species. [There are now several well-known species of these animals. The *Canis primævus*, Hodg., *C. Dukhunensis*, Sykes, is a large red Jackal, or Jackal-like Dog, inhabiting India, and very like the Dingo of Australia.]

FOXES [*Vulpes* of some naturalists] may be distinguished from Wolves and Dogs by having the tail longer and more bushy [though in this respect there is no drawing the line of separation], by a more pointed muzzle, and pupils which, during the day, form a vertical fissure; also by their upper incisors being less sloping; they emit a fœtid odour [scarcely less offensive in the Jackals], dig burrows, and attack only the weaker animals; [are also more frugivorous than the preceding.*] This subgenus is more numerous than the foregoing.

The Common Fox (*C. vulpes*, Lin.)—More or less rufous, with the extremity of the tail [generally] white. Is found from Sweden to Egypt, [though many of those of the south of Europe appertain to a different species, *C. melanogaster*, Savi, which is smaller and less carnivorous than the Common Fox, and differs somewhat in habit.† There are very many others, almost generally diffused over the globe. We can only mention]

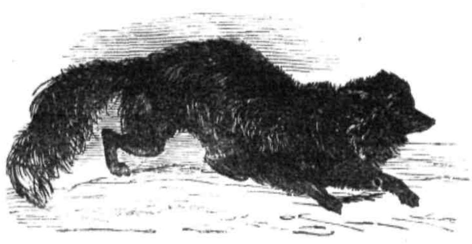

Fig. 29.—The Black Fox.

The Arctic or Blue Fox, or Isatis (*C. lagopus*, Lin.)—Deep ash-colour, often white in winter; the under surface of the toes hairy, (though several of the Foxes, and even the common one, have hair under the feet in the north). From the glacial regions of both continents, particularly the north of Scandinavia; is much esteemed for its fur.

The interior of Africa produces Foxes remarkable for the size of their ears, and the strength of their whiskers: they compose the *Megalotis*, Illiger. Two are known, the

C. megalotis, Lalande [*Megalotis Lalandi* of some authors], a Cape species, somewhat smaller than the Common Fox, but higher on its legs; [especially remarkable for possessing three tuberculous molars posterior to the cutting grinder of each jaw: its teeth become much worn with use, whence it would appear to be mainly frugivorous.] And

The Zerda, or Fennec of Bruce (*C. zerda*, Gm.), which has ears still larger; it is a very small species, almost of a whitish fulvous, with woolly hair extending beneath the toes; burrows in the sands of Nubia, [and ascends the trunks of trees with facility: dentition that of an ordinary Fox.]

Finally, we may place after the Dogs, as a fourth subgenus, distinguished by the number of toes, which are four to each foot,

The Wild Dog of the Cape (*Hyæna venatica*, Burch; *H. picta*, Tem. [*Lycaon picta*, Brookes]), which has the dental system of the Dogs [Civets, &c.], and not of the Hyænas; a tall gaunt form; fur marbled with white, fulvous, grey, and blackish; the size of a Wolf, with large ears tipped with black, &c. It lives in numerous packs, which often approach Cape-town, and devastate the environs. [This remarkable species

Fig. 30.—The Marbled Lycaon.

* The common Dog is an eager devourer of gooseberries, of which it will soon strip the bushes to which it has access.—ED.

† It is remarkable that many of the habits attributed to the Fox, in the old Greek fables, apply better to *C. melanogaster* than to *C. vulpes*.—ED.

is Dog-like, but certainly not a *Canis:* its form and colouring (and there is reason to suspect its internal conformation), are rather those of a Hyæna; and it is known to copulate in the manner of those animals, and not in the peculiar manner of the Dogs and Foxes. Even its dentition is the same as that elsewhere found, (with one other exception,—*Proteles,*) throughout the group to which we conceive the Hyænas to belong, the dental system of which latter appears to be modified in accordance with their much increased and prodigious strength of jaw.]

THE CIVETS (*Viverra*),—

Have three false molars above and four below, the anterior of which sometimes fall out; two tolerably large tuberculous teeth above, one only below, and two tubercles projecting forwards on the inner side of the lower carnivorous tooth, the rest of that tooth being tuberculous. The tongue is covered with sharp and rough papillæ. Their claws are more or less raised as they walk; and near the anus is a pouch more or less deep, where an unctuous and often odorous matter is secreted by peculiar glands.

They divide into four subgenera.

THE TRUE CIVETS (*Viverra*, Cuv.),—

In which the pouch, large, and situate between the anus and the genitals, divided also into two sacs, is abundantly supplied with a pommade having a strong musky odour, secreted by glands which surround the pouch. This substance is an article of commerce, much used in perfumery. It was more employed when musk and ambergris were little known. The pupil of the eye remains round during the day*, and their claws are only semi-retractile.

[Four species are known, from Africa and India: beautiful spotted animals, larger than a domestic Cat: they have an erectible mane along the back (as in the Hyænas), more or less conspicuous: are of an indolent disposition, and easily tamed; feed partly on fruits; and when irritated raise the dorsal mane, and hiss like Cats.]

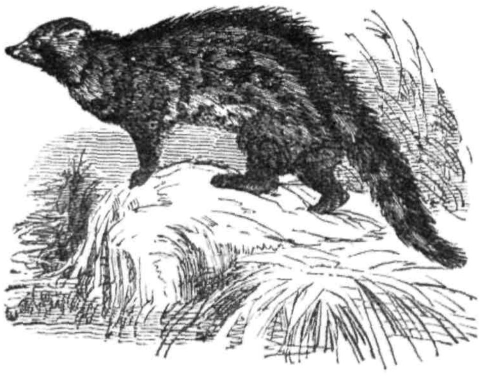

Fig 31.—The African Civet

THE GENETS (*Genetta*, Cuv.),—

Have the pouch reduced to a slight depression formed by the projection of the glands, with scarcely any discernible secretion, although diffusing a very perceptible odour. In the light, their pupil forms a vertical fissure; and their claws are completely retractile, as in the Cats. [They are smaller and more slender animals than the Civets, from which they scarcely differ in style of colouring: are also partly, but less, frugivorous, and in general easily tamed.

The species are numerous, and inhabit the same general locality as the preceding. One (*Viv. genetta*, Lin.)] is found from the south of France to the Cape of Good Hope. It frequents the edges of brooks, near springs, &c., and its skin forms an important article of traffic.

[THE GALET (*Cryptoprocta*, Ben.)—

Would appear, from its dentition, to be the most carnivorous of the Viverrine quadrupeds: its jaws are much abbreviated, and there are only two false molars to each: claws wholly retractile.

The species (*C. ferox*, Ben.) is little larger than a Stoat, and uniformly brown, with large ears: an inhabitant of Madagascar. *Euplere*s (Jourdan?) would seem to be allied.

THE DELUNDUNG (*Prionodon*, Horsf.)—

Is also allied to the Genets, but with the false molars three-lobed or serrated.

Felis and subsequently *Pr. gracilis*, Horsf., is the only species; a rare Javanese animal, of slender form, very handsomely streaked and spotted.]

* Indicating that they inhabit the open country. See the Cats (*Felis*).—ED.

THE MUSANGS (*Paradoxurus*, F. Cuv.)—

Possess the teeth and most of the characters of the Genets, with which they were long confounded: but their general form is stouter, and their gait plantigrade: what more particularly distinguishes them, however, is the spiral inclination of the tail*, which is not prehensile.

Only one species is known, the Pougonné of India (*P. typus*, F. Cuv.), termed *Palm Marten* by the French in India. [No less than ten or twelve have since been discovered, chiefly from India and the great Asiatic islands, though some inhabit Africa. They feed much on fruit, but are also tolerably carnivorous, springing upon their prey from a place of ambush: gait slow and plantigrade, with the head and tail lowered, and the back arched; but they also advance by rapid digital bounds, and are excellent climbers, constructing a nest on the forked branches of trees. They are easily tamed, and, when angry, growl and spit like Cats: sleep rolled up in a ball, &c.

As the Dogs may be considered the highest of the *Carnivora*, and the Cats the most eminently predaceous, so the Musangs may be regarded as presenting the fairest *average* of a member of this division. Their dentition is scarcely distinguishable from that of the Dogs; but, on reverting the cranium, their cerebral cavity is seen to be proportionally smaller.

Various species of Musang have been named as separate subgenera by different systematists. *Ambliodon*, Jourd., is the *Ictide dorée* of M. F. Cuvier; and *Paguma*, Gray, refers to the young of *P. larvatus*. *P. Derbianus*, Gray, a species approximating the Genets, of a fulvous-grey colour, with broad cross bands of dark brown, is the *Hemigalea zebra* of Jourdan. Most of them present the streaks and spots of the Genets, but on a darker ground-tint.

Several affect the vicinity of human habitations, and are very destructive to poultry, their eggs, &c.

THE CYNOGALE (*Cynogale*, Gray; *Limictis*, Blainv.)—

Is an aquatic representative of the preceding, to which it bears a similar relation to that which the Otters hold with the Weasels. Its false molars are large, compressed, sharp, and slightly notched or serrated; and entire dental system, together with its external characters, generally modified for a piscivorous regimen.

One species only is known (*C. Bennettii*, Gr.; *Viv.* and *Lim. carcharias*, Bl.)—A native of Sumatra, uniform dark brown; the ears small: head, and also colouring, very similar to that of a common Otter: its tail, however, is cylindrical.]

THE MANGOUSTES (*Mangusta*, Cuv.; *Herpestes*, Ill.†)

The pouch voluminous and simple, and the anus situate within its cavity; [bony orbits of the skull most usually perfect.] Their hairs are annulated with pale and dark tints, which determine the general colour of the eye. [Tail long as in the preceding subdivisions, and bushy towards its insertion.

The species are very numerous; and] that of Egypt (*Viv. ichneumon*, Lin.), so celebrated among the ancients by the name of *Ichneumon*, is grey, with a long tail terminated by a black tuft; it is larger than our Cat, and as slender as a Marten. It chiefly hunts for the eggs of the Crocodile, but also feeds on all sorts of small animals; brought up in houses [where, in common with its congeners, it is readily domesticated, and exhibits much intelligence and attachment], it pursues Mice, reptiles, &c. By the Europeans at Cairo it is designated *Pharaoh's Rat*, and *Nems* by the natives. The ancient allegation of its entering the throat of the Crocodile, to destroy it, is quite fabulous. The common Indian species (*Viv. mungos*, Lin.) is celebrated for its combats with the most dangerous serpents; and for having led us to a knowledge of the *Ophiorhiza mungos* as an antidote to their venom. [Some are less vermiform in their make, and higher on the legs: one, termed the *Vansire* by Buffon, forms the division *Athylax* of M. F. Cuvier; others compose the *Galidea* and *Ichneumonia* of M. Is. Geoffroy: *Cynictis*, Og., includes several species with only four toes to each foot; and *Lasiopus* and *Mongo*, Auct., are additional dismemberments of this genus. The *Urva* of Mr. Hodgson appears also to be a Mangouste, with incomplete orbits.]

THE SURIKATE (*Ryzæna*, Ill.)—

Resembles the Mangoustes, even to the tints and annulations of its fur; but is distinguished from them, and from all the *Carnivora* hitherto mentioned [save the *Lycaon picta* and *Cynictis*, just indicated], by having only four toes to each foot. It is also higher upon the legs, and does not possess the small molar immediately behind the canine. The pouch extends even into the anus.

Only one is known (*Viv. tetradactyla*, Gm.), a native of Africa, and rather smaller than the Mangouste of India.

THE MANGUE (*Crossarchus*, F. Cuv.),—

Has the muzzle, teeth, pouch, and gait of the Surikate; the toes and genital organs of the Mangoustes.

* In those which I have seen alive, including *P. typus*, this character was not perceptible: the individual figured by M. F. Cuvier presenting a morbid deformity, an analogous instance of which occurred to a Leopard formerly exhibited in London.—ED.

† This term is more generally adopted. The name *Ichneumon*, formerly applied to the animals of this genus, has been transferred to a very extensive group of Hymenopterous Insects.—ED.

We know but of one (*Cr. obscurus*, F. Cuv.), from Sierra Leone: size of a Surikate. [Other Mangoustes are included by recent systematists; and it may be remarked that both this and the preceding subdivision are merely slight modifications of *Herpestes*, and have similar perfect orbits.]

We shall here mention a singular animal from South Africa, which is known only when young, and which has five toes before, four behind, and the head a little elongated as in the Civets, the legs raised, those behind rather shorter, and a mane as in the Hyæna; and which also resembles the Striped Hyæna very remarkably in its colouring. Its anterior thumb is short, and placed high up. The *Proteles Lalandi*, Is. Geof.; an inhabitant of caverns.

Fig. 32.—Proteles Lalandi.

The individuals examined, which were all young, possessed but three small false molars, and one small tuberculous back molar. It seems as though their teeth had never come to perfection, as often happens in the Genets. (See my *Ossemens fossiles*, iv. 388.) [The permanent canines are of tolerable size, but the simple form of the molars, all very small, and separated by intervals, presents an anomaly among the *Carnivora*, which is even more remarkable on account of the affinity of this species to the Hyænas. It is destructive to very young lambs, and is stated to attack the massive fatty protuberance on the tails of the African Sheep.]

The last subdivision of the Digitigrades has no small teeth whatever behind the large molar of the lower jaw. It contains the most sanguinary and carnivorous of the class. There are two genera.

THE HYÆNAS (*Hyæna*, Storr)—

Have three false molars above and four below, all conical, blunt, and singularly large: their upper carnivorous tooth has a small tubercle within and in front; but the lower one has none, presenting only two stout cutting points. This powerful armature enables them to crush the bones of the largest prey. Their tongue is rough [exhibiting a circular collection of retroflected spines]; all their feet have each but four toes, as in the Surikate; and under the anus is a deep and glandular pouch, which led the ancients to believe that these animals were hermaphrodite. The muscles of their neck, and of the jaws, are so robust, that it is almost impossible to take from them anything they may have seized; whence, among the Arabs, their name is the symbol of obstinacy. It sometimes happens that their cervical vertebræ become anchylosed in consequence of these violent efforts; and thus has arisen the opinion that the animals of this genus have only one bone in their neck. They are nocturnal animals, and inhabit caverns; voracious, subsisting chiefly on dead bodies, which they will even disinter from the grave, a habit that has given rise to a multitude of superstitious traditions.

Three species are known. The striped Hyæna (*H. vulgaris*, *Canis hyæna*, Lin.), found from India to Abyssinia and Senegal. The spotted H. (*H. crocuta*, Schreb., *C. crocuta*, Lin.,) from South Africa; and the Woolly Hyæna, (*H. bruanea*, Thunb., *H. villosa*, Smith), also from South Africa. Remains of a fossil species (*H. spelæa*) are found in many cavern deposits of France, Germany, and England. [Hyænas are easily tamed, if allowed their liberty, and are susceptible of strong attachment to those who use them kindly: many are employed in the capacity of watch-dogs both in Asia and Africa. They are physiologically nearly related to the Civets, and not to the Dogs*; and the loss of the posterior tuberculous molar appears to be a consequence of the great increase in size of the carnivorous grinders: notwithstanding which these animals feed much on bulbs.]

THE CATS (*Felis*, Lin.)—

Are, of all the *Carnaria*, the most completely and powerfully armed. Their short and rounded muzzle, short jaws, and especially their retractile talons, which, being raised upward when at rest, and closing within the toes, by the action of elastic ligaments, lose neither point nor edge, render them most formidable animals, more particularly the larger species. They have two false molars above, and two

* Their rough tongue, small and not spiral cæcum, the structure of their reproductive organs, and consequent mode of copulation; their anal pouch, style of colouring, &c., combine to indicate their true position to be as above assigned.

below: the upper carnivorous tooth three-lobed, with a broad heel on its inner side; the inferior with two pointed and cutting lobes, and without any heel: finally, they have only one very small upper tubercular, and no corresponding one in the lower jaw. [These animals creep unawares upon their prey, and seize it with a sudden spring, in which they expend their energy.] The species are exceedingly numerous, and vary much in size and colour, but they are all nearly similar in structure. We can only subdivide them by characters of trivial import, as size, and the length of fur.

At the head of this genus ranks

The Lion (*Felis leo*, Lin.), the most powerful of the beasts of prey; distinguished by its uniform tawny colour, the tuft of black hair at the end of the tail, and the flowing mane which clothes the head, neck, and shoulders of the male. Formerly inhabiting the three divisions of the ancient world, it appears to be now confined to Africa, and the neighbouring parts of Asia. Its head is squarer than in the following species. [The Lion is subject to considerable variation, chiefly as regards the quantity of mane, and lengthened hair on other parts: those of Guizerat are almost destitute of any; the Lions of Africa present the greatest quantity, in many of which there is a median line of long hair extending along the belly; but even these differ one from another: there is also considerable difference of physiognomy between the African and Asiatic Lions, and the latter are always paler, and reputed to be less courageous; but there is no difference of size and apparent strength. Those who distinguish the Lions of Asia and Africa as different species, might change their opinion on seeing the various adults now living in London.]

Tigers are large species with short hair, and commonly exhibiting vivid markings. [We may here observe that it is quite impossible to subdivide the genus *Felis* into definite sections, and that every attempt of this kind hitherto made has consequently proved a complete failure: the transition into the Lynxes is most gradual; and the spotless species (as the Lion, Puma, &c.) are marked like the rest when young. Those species, however, which affect the open country, as the Lion and Leopard, have the pupil of the eye contracting to a point; whereas in those which inhabit forests, as the Tiger and domestic Cat, the pupil closes to a vertical line, permitting thus, when least dilated, of a full range of vision, in the direction in which these animals chiefly watch for prey. A few of the more conspicuous may be briefly indicated.]

The Tiger (*F. tigris*, Lin.)—As large as the Lion, but with the body longer and head rounder; of a bright reddish-buff above, with irregular black transverse stripes, and pure white underneath; [the hair surrounding the head elongated]: the most cruel of quadrupeds, and the scourge of the East Indies. Such are the strength and the velocity of its movements, that during the march of an army it has been known to seize a soldier while on horse-back, and bear him off to the jungle, without affording a chance of rescue. [This species also occurs, sparingly, in northern Asia. Its markings vary much in different individuals.]

The Jaguar (*F. onca*, Lin.) of America.—Nearly as large as the preceding, and scarcely less dangerous: it is beautifully spotted with rings more or less complete, and containing smaller spots [on a deeper ground-tint: the space included within the annulations of all the spotted Cats being deeper coloured than the rest of the body.] Black individuals sometimes occur, which have the spots more intense, and visible only at particular angles, [the fur of the spots differing in texture: the same has been observed of the Tiger and Leopard, and albino individuals of the former have likewise been noticed. Jaguars also differ much one from another].

The Panther (*F. pardus*, Lin.: *Pardalis* of the ancients.)—[Covered with annular series of irregular small spots.] It is widely spread over Africa, the hottest region of Asia, and also the Indian archipelago.

Fig. 33.—Tiger-cat of Sumatra.

The Leopard (*F. leopardus*, Lin.)—[Very like the Panther, but with the markings less broken into small spots: it varies, however, considerably, and the two sides of the same animal do not always resemble: from Asia and Africa.] These two species are smaller than the American Jaguar [and are very doubtfully separable from each other.

The Ounce of Buffon (*F. uncia*, Gm.) is a long-haired mountain Cat, as large as a Leopard, with tail longer than the body: also similarly spotted, but more obscurely, and on a paler ground-tint. It inhabits the Asiatic mountains, and a fine specimen of it has lately been deposited in the British Museum.

Of the other spotted Cats, may be mentioned the *F. chalybeata*, Herm., from the north of India; and *F. viverrina*, Ben., from Sumatra*: also the Rymau-dyan (Fig. 33), or gigantic Tiger-cat of Sumatra (*F. macroscelis*), and the nearly allied but smaller Marbled Cat (*F. marmorata*), from the same locality, which are remarkable for length of tail. The Ocelot of South America (*F. pardalis*,

* Notwithstanding its name, this species presents no real approach to *Viverra* its cranium, for instance, being strictly that of a *Felis*.

Lin.), twice the size of a large domestic Cat, and comparatively lower on the legs, is marked somewhat like the Jaguar, but with a tendency to a linking of the spots into longitudinal bands, more or less observable in different individuals.* *F. Sumatranus* and *Bengalensis* are not larger than a House-cat, but coloured like the foregoing; though individuals commonly occur of the same greyish ground-tint as the majority of the smaller species. A beautiful European Cat, with the markings of the Leopard group, is the *F. pardina*, Oken, which inhabits the mountains of Spain; its tail, however, is short, as in the following. There are many others].

Lynxes are short-tailed Cats, with mostly pencil-tufts to their ears, and fur generally spotted more or less distinctly: those of cold countries have the fur long. A species little less than a Leopard (*F. lynx*, Lin.) still inhabits the mountainous parts of Europe, from Scandinavia to Spain and Naples, and, it is said, the north of Africa also. [Prof. Nilsson distinguishes three large European species in Scandinavia, and figures different varieties of each.] The Canada Lynx is smaller, with very long fur, which extends even under the toes; [it is allied to the Wild Cat of Britain. There are many others, some, as the Pampas Cat (*F. pajeros*) grading into the next group. We can only notice a handsome short-haired species, the Caracal of Turkey and Persia, almost uniform bright vinous red; it is the true Lynx of the ancients. The Chati (*F. Serval*, F. Cuv.), an elegant spotted species, of slender form, and very high upon the legs, may be approximated to this group, and indeed has a moderately short and singularly mobile tail: it inhabits Africa. Allied to it is the Chati (*F. mitis*), a native of South America.

Fig. 34.—Felis Lynx.

Approaching the domestic Cat in size, colour, and markings, are also numerous species, among which the native Cat of Britain (fig. 35) may be particularized, distinguished by its tail not tapering as in the tame Cat; it is also larger, but with much shorter intestinal canal, though it is probable that the length of intestine in the common Cat may have been gradually induced by long-continued habituation to a less carnivorous regimen, operating through many successive generations. The domestic Cat is referred by Temminck to his *F. maniculata*, a species wild in Egypt; but is probably a mingled race, derived from several distinct wild stocks: our author, in his last edition, referred it to the European Wild Cat, but subsequently retracted his opinion: the Angora variety of it is perhaps the most remarkable, being covered with long silky hair. Of the spotless species, may be mentioned]

The Cougar, Puma, or pretended Lion of America (*F. concolor*, Lin.) (Fig. 36.)—Red [silvery or greyish-red], with small spots of a slightly deeper colour, which are not easily perceived [nor always present in the adults, and a small black tuft at the end of the tail. Size nearly that of a Leopard], from both Americas, where it preys on Sheep, Deer, &c. [and has been known, though very rarely, to attack mankind. An allied species, redder, and with shorter tail, exclusively from South America, is known as *F. unicolor*; and there is a small species also very similar, the Eira of Azzara, the tail of which is not tufted. The Jaguarondi is another from the same locality, of medium size, altogether of a blackish-brown, more or less dark, and rather low on the legs: and there is a deep reddish-brown Cat in India, scarcely larger than the

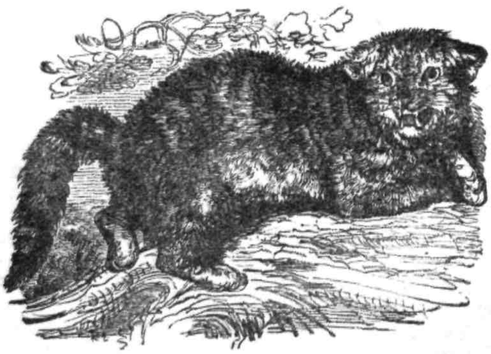

Fig 35.—Wild Cat.

* As a warning against relying too much upon the proverbially uncertain temper of these eminently carnivorous animals, may be mentioned a fact which occurred not long ago in France. A gentleman had succeeded in taming an Ocelot, which for three years enjoyed the range of his house and garden as freely as a domestic Cat, appearing thoroughly reclaimed. One evening, however, at the fire-side, when a child of three years old was playing with it, as it had often done before, the animal, being irritated, seized the infant by the throat, and killed it before assistance could be rendered. An instance has occurred in this country of a babe being attacked by a tame Ferret. The Domestic Cat is undoubtedly more susceptible of attachment than it has been generally described; and it is surprising to perceive how patiently it bears the rough handling of children. We have seen it hail the return of persons it knew with as lively joy as any animal could well testify, and this in the case of individuals who had never fed it: but it is understood, with what general truth may perhaps be questioned, that while the Dog will mourn and even pine to death over the body of its master, the Cat feels no compunction in making it its prey: it is needless to observe, however, that the intellect of the Cat is very much inferior to that of the Dog, on which account some allowance may be granted.

With respect to the Domestic Cat, also, another consideration may be borne in mind, which is, that there can be little doubt that its nature has been considerably modified by domestication, which has gradually rendered it less exclusively carnivorous than its wild congeners. It is even remarkable that instances of the rapacity of this animal towards young children are not of frequent occurrence.—ED.

domestic, named *F. Temminckii: F. planiceps* approximates the last, but is smaller, with some markings on the head, and is remarkable for its complete bony orbits.]

We might place as a separate subgenus [*Cynailurus*, Blainv.?] a species which has the head rounder and shorter, and the talons of which are not retractile [a statement which is unwarranted by fact], the Chetah, or Hunting Leopard (*F. jubata*, Schreb.): size of a Leopard, but longer-bodied, and stands higher; of a pale fulvous, with tolerably uniform small black spots, a black streak reaching from the eye to the angle of the mouth, and tail annulated at the end. The disposition of this animal is mild and docile. [From Asia and Africa, but apparently not specifically the same on the two continents.

Fig. 36.—The Puma

The DIGITIGRADA of Cuvier, exclusive of the semi-plantigrade genera which have no cœcum, divide primarily into, first, the Canine group, or the Dogs and Foxes, which is the most distinctly separated by anatomical characters; the remainder are all much more nearly allied, but we may venture to detach the Feline animals or Cats: the rest may all be included in the Viverrine section, to which the Hyænas strictly appertain; a varied, but quite natural assemblage, exclusively confined in its distribution to the eastern continent, and scarcely extending beyond the tropics; whereas the former groups are generally diffused, with the exception of Australia and the remote oceanic islands. Of the Viverrine animals, the most definitely characterized subdivision is that of the Mangoustes and subordinate sections: the Genets scarcely differ from the Cats except in the prolongation of the muzzle; and the Hyæna group is so nearly related to the Civets that it does not appear to be separable on physiological characters.]

THE AMPHIBIA [PINNIGRADA, Blain.]—

Compose the third and last of the minor tribes into which we divide the CARNIVORA. Their feet are so short and so enveloped in the skin, that, upon land, they only serve to crawl with*; but, as the intervals between their toes are occupied by membranes, they form excellent oars: hence these animals pass the greater portion of their lives in the water, which they only quit to bask in the sunshine, and to suckle their young. Their lengthened body; their very moveable spine, provided with muscles which strongly flex it; their narrow pelvis; their short close fur, setting flat upon the skin; all combine to render them able swimmers, and the details of their anatomy confirm these first indications. [As in the Dugong, the *Cetacea*, and other large aquatic Mammalia, their bones are light and spongy, more particularly in the larger species.] Only two genera have as yet been distinguished, the *Seals* and the *Morses*.

THE SEALS (*Phoca*, Lin.)—

Have six or four incisors above, four or only two below, pointed canines, and grinders to the number of twenty, twenty-two, or twenty-four [that is to say, two, in the complete series, posterior to the representative of the carnivorous tooth], all of them trenchant or conical, without any tuberculous portion: five toes to each foot, the anterior successively shortening from the thumb; whereas,

* It is only when clambering that the Seal employs its feet on land · it wriggles along, upon the ground, by the action of the abdominal muscles.—ED.

in the hind feet, the outer and inner toes are the longest, and the intermediate comparatively short. Their fore-feet are enveloped in the integuments of the body as far as the wrist, the hinder almost to the heel; between the latter is a short tail. The head of a Seal resembles that of a Dog; and they have the same intelligence and mild and expressive physiognomy. They are easily tamed, and become much attached to their feeder. The tongue is smooth, and notched at the end, their stomach simple, cœcum short, intestinal canal long, and tolerably regular. These animals subsist on fish, which they always devour in the water, and are enabled to close their nostrils when diving, by means of a sort of valve. As they remain long below the surface, it was supposed that the *foramen ovale* continued open as in a fœtus, which is not the case: they have a large venous cavity, however, in their liver, which assists them in diving, by rendering respiration less necessary to the motion of the blood. The latter is very abundant and very dark.

Analogous to *Calocephala*, THE SEALS, (properly so called, or without external ears),—

Have the incisors pointed; all their toes enjoy a certain degree of motion, and are terminated by pointed nails placed on the edge of the connecting membrane.

They may be divided according to the number of their incisors. In

Calocephala, F. Cuv. [*Phoca*, as restricted],—

There are six above and four below. [The cheek-teeth have more than one root; and besides the main cutting point, there is on each an anterior smaller one, and two posterior. The brain is in this division amply developed, and the intelligence proportionate.]

The common Seal (*Ph. vitulina*, Lin.; *Ph. littorea*, Thiem.)—Common on the coast of Europe in vast herds, and extending far to the north. The European seas, however, contain several *Phocæ*, which have been long confounded, some of which are perhaps varieties of the others; as *Ph. hispida*, Schreb.; *Ph annellata*, Nills.; *Ph. fœtida*, Fabr., &c. [Those of the British islands much require elucidation.] A species more easily recognized is

The Harp Seal (*Ph. groenlandica* and *oceanica*, Auct.), from the whole north of the globe. [Remarkable for the difference in marking between the adult male (fig. 37) and the female and young; length five feet. It pertains to the British fauna, as does also the next species, according to report, for which the *Halichœrus griseus*, however, has been generally mistaken.]

Bearded Seal (*Ph. barbata*, Fabr.), a northern species, surpassing all the preceding ones in size, which is from seven to eight feet. Its moustaches are thicker and stronger than in the others. [Several more are known from the northern hemisphere.]

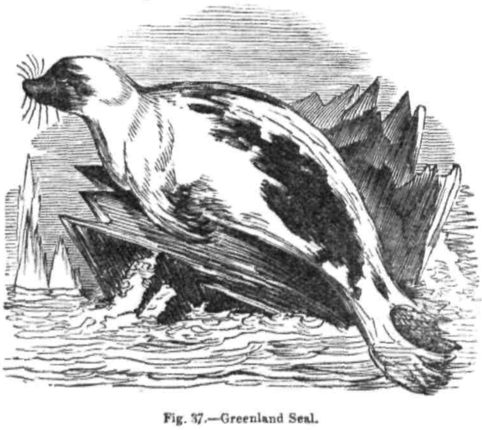

Fig. 37.—Greenland Seal.

THE STERRINCKS (*Stenorhynchus*, F. Cuv.)—

Possess four incisors to each jaw, and cheek-teeth deeply notched into three points (fig. 38), [but with single roots: the muzzle slender and much elongated; and very small claws].

One only is known (*Ph. leptonyx*, Bl.), from the Austral seas: size of the Bearded Seal. [An allied species constitutes

THE LEPTONYX (*Leptonyx*, Gray)—

The grinders of which are bluntly three-lobed, the muzzle broad and rounded, and hind feet clawless.

Otaria Weddellii, Lesson.—Also from the South Seas].

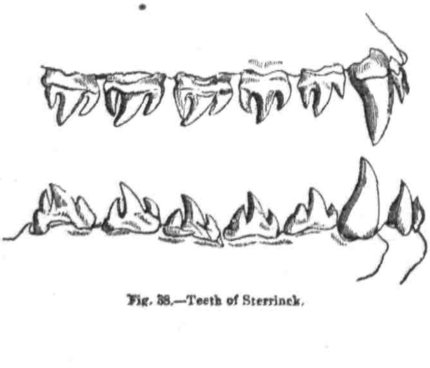

Fig. 38.—Teeth of Sterrinck.

THE MONK (*Pelagius*, F. Cuv.)—

Also possesses four incisors to each jaw; but the grinders form obtuse cones, with a slightly marked process before and behind. There is one in the Mediterranean,

Ph. monachus, Gm., from ten to twelve feet in length. It is particularly found among the Grecian and Adriatic Isles, and was probably the species best known to the ancients.

[THE HALKETS (*Halichœrus*, Nilsson).

Grinding teeth of the upper jaw simple; those of the lower with an inconspicuous tubercle before and behind. Muzzle deep and obliquely truncated: the head flat, and brain comparatively very small.

H. gryphus, Nils., a species nearly as large as the Bearded Seal, inhabits the Baltic and British seas, where it would seem to be not uncommon. Its intelligence has been observed to be very inferior to that of the true *Phocæ*.]

THE HOODCAP (*Stemmatopus*, F. Cuv.).

Four superior, and two inferior incisors; the grinders compressed and slightly three-lobed, supported by thick roots.

Ph. cristata, Gm.; *Ph. leonina*, Fabr.—A species attaining a length of seven or eight feet, with loose skin upon the head, which can be inflated into a sort of cowl, and is drawn over the eyes when the animal is menaced, at which time the nostrils also are puffed out like bladders. From the Arctic Ocean.

Finally,

THE MYROUNGAS (*Macrorhinus*, F. Cuv.; [*Cystophora*, Nilsson,])—

Possess, with the incisors of the preceding, obtuse conical molars (fig. 39) [but massive canines], and muzzle lengthened into a short moveable proboscis. The largest known Seal is of this subgenus; the

Fig. 39.—Teeth of Myrounga

Ph. leonina, Lin.—Twenty to twenty-four feet in length [sometimes thirty, according to English measure, and of great proportionate bulk]. Brown, the muzzle of the male terminated by a wrinkled snout, which becomes inflated when the animal is angry. It is common in the southern latitudes of the Pacific Ocean, and of great request for the quantity of very superior oil with which it abounds.

Those with external ears,

THE OTARIES (*Otaria*, Peron),—

Are worthy of being formed into a separate genus, inasmuch as, besides the projecting auditory conch, the four middle upper incisors have a double cutting edge (a structure not hitherto remarked in any other animal); the exterior are simple and very small, and the four inferior forked: the molars are all simply conical. The toes of their anterior swimming-paws [which are placed far backward] are almost immoveable; and the membrane of their hind feet is prolonged into a flap beyond each toe: all the nails are thin and flat.

Ph. jubata, Gm. (*Sea Lion* of Steller, Pernatty, &c., but not of Anson, which refers to the Myrounga; the latter being also the *Sea Wolf* of Pernatty). From fifteen to twenty feet [French], and more, in length: the neck of the male covered with more frizzled and thickly-set hairs than those on the other parts of the body. From the South Pacific.

[The Falkland Otary, or *Fur Seal* of commerce (*C. Falklandia*, Desm.)—Remarkable for the great disproportionate size of the sexes (if, indeed, the same does not apply to all its congeners); the full-grown male, according to Weddell, measuring 6 ft. 9 inch.; the female only 3½ feet. It is polygamous, in the proportion of one male to about twenty females. The fur is an esteemed article of commerce; and so abundant was the species formerly in various localities, that for a period of fifty years, not less than 1,200,000 skins were annually obtained from a single island].

Fig. 40.—The Ursal.

The Ursal (*Ph. ursina*, Gm. [*Arctocephalus ursinus*, F. Cuv. fig. 40.]—Eight feet long, no mane, varying from brown to whitish. From the north of the Pacific Ocean.

THE MORSE (*Trichecus*, Lin.)—

Resembles the Seals in the general form of its body and limbs, but differs considerably from them in the head and teeth. The lower jaw has neither incisors nor canines, and is compressed anteriorly to pass between two enormous canines or tusks which issue from the upper one, and which are directed downwards, attaining sometimes a length of two feet, with proportionate thickness. The magnitude of the sockets requisite for holding such enormous canines raises up the whole front of the upper jaw, so as to form a thick bulging muzzle, the nostrils opening upwards, instead of being terminal. The molars are all short cylinders, obliquely truncated. There are four [or five] on each side above and below; but at a certain age, two of the upper ones fall out. Between the canines are two incisors similar to the molars, which the majority of observers have overlooked, as they are not fixed in the intermaxillary bones; and between these again, in young individuals, are two pointed and small ones.

The stomach and intestines of the Morse are nearly similar to those of the Seals: and it appears that they subsist on fuci as well as on animal substances.

One species only has been ascertained, the Morse or Walrus (*Tr. rosmarus*, L.); an inhabitant of all parts of the Arctic seas, exceeding the largest Bull in bulk; it attains a length of twenty feet, and is covered with short yellowish hair. This animal is much sought for on account of its oil and tusks; the ivory of which, though coarse grained, is employed in the arts. The skin makes excellent coach-braces. [A strange assertion originated with Sir E. Home, that the feet of the Morse possess suckers, by which it is enabled to ascend perpendicular ice-bergs. There is no foundation for this statement.

It is difficult to intercalate the *Amphibia* in the series of *Carnivora*, and to determine to what extent their peculiarities should be regarded as adaptive modifications, based on the rudimental structure of the whole order.

At the head of the *Carnivora* we prefer to place the Dogs or *Canidæ*, followed by the *Viverridæ* and *Felidæ*: the Seals or *Phocidæ* might, we conceive, next range with less impropriety than elsewhere: and after them the *Mustelidæ*, and *Ursidæ*; then, finally, the *Insectivora*, which the author ranks as equivalent to all the foregoing. The *Cheiroptera*, or Bats, we deem to be subordinate rather to the preceding order.

Remains of nearly all the principal genera and some additional ones have been found, more or less abundantly, in the tertiary strata, or deposits overlying the chalk, but not in beds of anterior formation.]

THE FOURTH ORDER OF MAMMALIANS—

MARSUPIATA,—

(*Or that of the Pouched Animals,*)—

With which we formerly terminated the CARNARIA, as a fourth family of that great ordinal division, presents so many singularities in the economy of its members, that we are induced to separate and elevate it to its present position; the more particularly, as we observe in it a sort of representation of three very different orders.

The first of all their peculiarities is the premature production of their young, which are born in a state of developement scarcely comparable to that of an ordinary fœtus a few days after conception. Incapable of motion, and barely exhibiting the rudiments of limbs and

other external organs, these minute offspring attach themselves to the teats of their mother, and remain fixed there until they have acquired a degree of developement analogous to that in which other animals are born. The skin of the abdomen is almost always so disposed around the mammæ as to form a pouch, in which these imperfect young are preserved as in a second uterus; and into which, long after they can walk, they retire for shelter on the apprehension of danger. Two peculiar bones attached to the pubis, and interposed between the muscles of the abdomen, support the pouch, [and prevent inconvenient pressure of the young, when grown, upon the bowels.] These bones are also found in the male, and even in those species in which the fold that forms the pouch is scarcely visible.

The matrix of the animals of this order does not open by a single orifice into the extremity of the vagina, but communicates with this canal by two bent lateral tubes. The premature birth of the young appears to depend on this singular organization. The scrotum of the male, contrary to what obtains in other quadrupeds, hangs before the penis, which at rest is directed backwards.

Another peculiarity of the *Marsupiata* is, that, notwithstanding a general resemblance of the species to each other, so striking that they were all long included in one genus, they differ so much in the teeth, the digestive organs, and the feet, that if we rigidly adhered to these characters, it would be necessary to separate them into distinct orders. They carry us by insensible gradations from the *Carnaria* to the *Rodentia**, and there are even some animals which have the pelvis furnished with similar bones; but which, being destitute of incisors and even of any sort of teeth, have been approximated to the *Edentata*, where, in fact, we shall leave them, under the name of *Monotremata*. [The latter are now more properly included as a second *order* of the same superior division of Mammalia which contains the *Marsupiata*, by the general consent of physiologists.]

In brief, it may be stated that the *Marsupiata* form a distinct class, parallel to that of ordinary quadrupeds, and divisible into similar orders; so that, if we were to arrange these two classes into even columns, the Opossums, Dasyures, and Bandicoots, would be opposed to the insectivorous *Carnaria*, such as the Tenrecs and Moles; the Phalangers and Potoroos to the Urchins and Shrews; while the Kangaroos, properly so called, could not well be compared with any other genus; but the Wombat should be placed opposite the *Rodentia*. Lastly, if we were to consider the bones of the pouch only [commonly designated *marsupial* bones], and regard as marsupial all animals which possess them, the Platypuses and Echidnas might compose a group parallel to the *Edentata*.

Linnæus ranged all the species which he knew under his genus *Didelphis*, signifying *double matrix*. The pouch is indeed in some respects a second one.

[The *Marsupiata*, together with the *Monotremata*, is now generally regarded as a distinct subclass, *Ovovivipara*, equivalent to the rest of the Mammalia. Its members are lower in their organization than any other mammiferous animals, approximating the oviparous type (and particularly Reptiles), in sundry details of their organization. The hemispheres of the brain, for instance, (which is much reduced in size,) are not united by a *corpus callosum*; and they are observed to be very defective in intelligence, as is indicated by their physiognomy†: the blood also is returned to the heart by two principal veins, as in Birds and Reptiles; and the sutures of the skull never become united. In short, they hold an analogous relation towards other Mammalia, to that which the *Batrachia* present to all other Reptiles. Their incisor teeth frequently exceed six in number, which is the maximum throughout the rest of the class,—another indication of their inferiority.

The geographic range of the *Marsupiata*, with the exception of the Opossum group peculiar to America, is at present almost confined to Australia and the neighbouring coun-

* Only upon the supposition that the gnawing teeth of the *Rodentia* are modified incisors, which is *more* than doubtful.—ED.

† A curious illustration of this inferiority on the part of the *Marsupiata*, is afforded by their turning to bite the stick with which they are smitten, rather than the hand that guides it.

tries, where they constitute, very nearly indeed, the only mammiferous animals; but fossil remains of them occur, sparingly, in the ancient *secondary* deposits of Europe, where hitherto no higher Mammalia have been detected. Consequently, the *Marsupiata* would appear to have been much earlier introduced upon our planet; a further indication, if not of their inferiority, at least of their intrinsical separateness as a group: there is reason also to suspect that at former epochs they were much more numerous, as well as generally diffused, than at present.*]

The first subdivision of them is distinguished by long canines, and small incisors to each jaw; the back molars are beset with pointed tubercles, and the general character of the teeth is the same as in the *Insectivora*, which these animals entirely resemble in their regimen.

THE OPOSSUMS (*Didelphis*, Lin.),—

Which of all the *Marsupiata* have been the longest known, compose a genus peculiar to America. They have ten incisors above, and eight below; three anterior compressed molars, and four sharply tuberculated back molars, the superior of which are triangular, the inferior oblong: so that, with the four canines, they have in all fifty teeth, a number greater than has as yet been observed in any other quadruped.† Their tongue is bristled, and the tail prehensile and in part naked; the hinder thumb is long and effectively opposable to the four other digits, whence the name *Pedimana* has been applied to these animals; it is not furnished with a nail. Their extremely wide mouth, and large naked ears, give them a peculiar physiognomy. The *glans penis* is bifurcated. They are fetid and nocturnal animals, whose gait is slow; nestle upon trees, and there pursue birds, insects, &c., without rejecting fruit: their stomach is small and simple, and the cœcum moderate and without enlargements.

The females of certain species have a deep pouch, wherein are placed their teats, and in which the young are inclosed.

Fig. 41.—Common Opossum.

The Common Opossum (*D. virginiana*, Pen. (fig. 41.) —Nearly the size of a Cat; fur, a mixture of black and white: it inhabits the whole of America, enters the villages at night, and attacks poultry, devouring their eggs, &c. The young at birth, sometimes sixteen in number, weigh only a grain each. Although blind and nearly shapeless, they find the nipple by instinct, and adhere until they have attained the size of a Mouse, which happens about the fiftieth day, at which epoch they open their eyes. They continue to return to the pouch until they are as large as Rats. The term of uterine gestation is only twenty-six days. [Several others are known; one of which] the Crab-eating Opossum (*D. cancrivorus*), frequents the marshes of the sea-coast, where it feeds chiefly upon crabs.

Other species possess no pouch, but merely a vestige of it, or fold of skin on each side of the belly. They habitually carry their young on their backs, the tails of the latter being entwined round that of the mother.

[A considerable number are known, from South America.]

THE YAPACH (*Cheironectes*, Illig.)—

[Is merely an aquatic Opossum, with semi-palmate toes.]

* Since writing the above, Prof. Blainville has published an elaborate Essay on the reputed *Marsupiata* of the secondary deposits, wherein he advances the opinion that these celebrated fossil remains appertain rather to reptiles of a higher organization than any now existing. M. Valenciennes and Prof. Owen have subsequently advocated the currently received opinion; while the first-named naturalist has been supported by Dr. Grant, who long previously had entertained the same idea. The question still remains *sub judice*; and it even appears that the objections to either solution of the difficulty are more weighty than the arguments in its favour.

† There are fifty-two teeth in the newly-discovered *Myrmecobius*. The multiplication of the teeth in the *Cetacea* is on a different principle.—ED.

The Yapach (*Did. palmata*, Geof.; *Lutra memina*, Bodd, fig. 42) frequents the rivers of Guiana.

Fig. 42.—The Yapach.

All the other Marsupials inhabit eastern countries, and especially New Holland; a land of which the mammiferous population seems even to consist principally of animals of this group.

[The three next genera, and probably the fourth, possess no cœcum.]

THE THYLACINES (*Thylacinus*, Tem.)—

Are the largest of this first division: they are distinguished from the Opossums by the hind-feet having no thumb, by a hairy and not prehensile tail, and two incisors less to each jaw; their molars are of the same number. They have accordingly forty-six teeth; but the external edge of the three large ones is projecting and trenchant, almost like the carnivorous tooth of a Dog: their ears are hairy, and of middle size.

But one [living] species is known, a native of Van Diemen's Land.—Size that of a [small] Wolf, but lower on the legs; of a greyish colour, barred with black across the crupper (*Did. cynocephala*, Harris). It is very carnivorous, and pursues all small quadrupeds. [This animal does not fish, as has been stated; nor is its tail compressed: it is principally nocturnal, and is called *Tiger* and *Hyæna* in its native island.] A fossil species of Thylacine has been found in the gypsum quarries of Paris.

THE PHASCOGALES (*Phascogale*, Tem.)—

Have the same number of teeth as the Thylacines; but their middle incisors are longer than the others, and their back molars more sharply tuberculated, in which respect they rather approximate the Opossums. They are also allied to them by their small size; the tail, however, is not prehensile: their posterior thumbs, though very short, are still distinctly apparent.

[Four species are now known, varying from the size of a Rat to that of a Mouse: they inhabit New Holland and Van Diemen's Land, where they live on trees, and pursue insects.]

THE DASYURES (*Dasyurus*, Geof.)—

Have two incisors and four grinders in each jaw less than the Opossums, so that they have only forty-two teeth; and their tail, everywhere covered with long hairs, is not prehensile. The hinder thumb is reduced to a mere tubercle, or even quite disappears, [as in the Thylacine]. They inhabit New Holland, and subsist on insects and dead carcases; they even penetrate into houses, where their voracity is very inconvenient. Their mouth is not so wide*, and the muzzle [much] less pointed, than in the Opossums; their ears also are shorter, and hairy. They do not ascend trees.

The Ursine Dasyure (*Did. ursina*, Harris).—Long coarse black hairs, with some white markings; the tail half as long as the body, almost naked underneath. Inhabits the north of Van Diemen's Land, and is nearly the size of a Badger. [This species, which is of common occurrence, is designated in Van Diemen's Land *the Devil*: it is nocturnal, and very destructive to Sheep, of a fierce disposition, bites severely, and is a match for an ordinary Dog: in common with the rest of its tribe, including the Thylacyar, it often sits on its haunches, and cleans its head with its fore-paws.]

The long-tailed Dasyure (*Das. macrourus*, Geof.)—Size of a Cat, with the tail as long as the body; fur brown, spotted with white both on the body and tail. The tubercle of the thumb is still well marked in this species, but in the following it can no more be seen.

Maugé's Dasyure (*Das. Maugii*, Geof.)—Rather smaller than the preceding, of an olive colour, spotted with white both on the body and tail: and lastly, *Did. viverrina*, Shaw; which is black, spotted with white, and no spots on the tail; a third less than the first. [These are still the only ascertained species, though it is probable that others remain confounded. The last is termed *Wild Cat* in Van Diemen's Land, and is very destructive to poultry, of which it only sucks the blood. These animals apply the entire sole of the hind-foot to the ground when standing.

THE MYRMECOBE (*Myrmecobius*, Waterh.)—

Has the greatest number of teeth of any known marsupial, fifty-two in all; namely, eight upper and

* I have been much astonished on witnessing the amazingly wide gape of the Ursine Dasyure.—ED.

six inferior incisors, and behind the canines four compressed molars in each jaw, and finally four small molars above, and five below, the latter pectinated internally in consequence of the irregularity of attrition; the canine of the lower jaw is much incurved. The form of this animal is similar to that of a Squirrel, but with a long and pointed muzzle, as in the Banxring: it has no thumb to the hind-foot.

The Banded Myrmecobe (*M. fasciata*, Waterh.)—Size of a Rat, and barred on the crupper similarly to the Thylacine, but with white bands on a reddish ground tint. The only specimens at present known were procured at Swan River settlement, Australia. This animal has been supposed to present the nearest living approach to the fossil *Thylacotherium* of the secondary lias.]

THE BANDICOOTS (*Perameles*, Geof.; *Thylacis*, Illig.)—

Have the hinder thumb short, as in the first Dasyures, and the two following toes joined by the skin as far as the claws; the thumb and little toe of their fore-feet are reduced to simple tubercles, so that there seem to be only three toes: the superior incisive teeth are ten in number, the most hindward pointed, and widely separated from the rest; below there are only six, [the posterior bilobate]; but their molars are the same as in the Opossums, [though less angular internally]. Their tail is hairy, and not prehensile. They inhabit Australia. The great claws of their fore-feet, almost straight, announce the habit of digging into the ground, and their rather long hind-feet that their gait is rapid [Their cœcum is of middle size, as in the Opossums, to which they are approximated by Prof. Owen.]

The Long-nosed Bandicoot (*P. nasutus*, Geof.)—Muzzle very much elongated; the ears pointed; fur a greyish brown. It resembles, at the first glance, a Tenrec. The *P. obesula*, Geof., is not so authentic. [The latter is now well established, as also another, *P. Gunnii*, from Van Diemen's Land, which is very generally diffused throughout that island; it lives principally on bulbs, but also on insects. Two or three more have been indi dicated, one of which, *P. lagotis*, Reid, is ranged by Prof. Owen as

THE PHILANDER (*Thalacomys*, Owen),—

The superior hindward incisor of which is close to the others, and the muzzle very long, and abruptly attenuated: auditory bullæ remarkably large, and divided posteriorly. The ears long, and the tail also long and bushy.

The only known species (*Per. lagotis*, Reid)—is a nimble-looking and handsome animal; greyish, and as large as the common Opossum. From New South Wales.]

In the second subdivision of Marsupials, there are two large and long incisors in the lower jaw, with pointed and trenchant edges sloping forwards, and six corresponding teeth in the upper one. The superior canines are still long and pointed; but those of the lower jaw are so small that they are often hidden in the gum: in the last subgenus there are even none below.

Their regimen is in great part frugivorous; hence their intestines, and particularly the cœcum, are much longer than in the Opossums. They have all a large thumb, so separated from the other digits that it seems directed backward as in Birds: it has no nail, and the two following fingers are joined by the skin as far as the last phalanx. It is from this circumstance that they have derived their name of

PHALANGERS (*Phalangista*, Cuv.)

THE RESTRICTED PHALANGERS (*Balantia*, Illig.)—

Have not the skin of the flank extended: they have on each jaw four back molars, all of which present individually four points, ranged in two rows; and before these a large one, conically compressed; also, between this and the upper canine, two small and pointed teeth, to which correspond the very small teeth below, of which we have spoken: their tail is always prehensile.

In some it is in great part scaly. They inhabit trees in the Molucca islands, where they feed on insects and fruit. At the sight of a man they suspend themselves by the tail; and if he gazes at them steadily for some time, they fall through lassitude. They diffuse an offensive odour, notwithstanding which their flesh is eaten.

Several species are known, of various size and colours, all of which are comprehended under the *Didelphis orientalis* of Linnæus. [Those in which the tail is partly scaly are peculiar to the Molucca islands, and constitute the division *Cuscus* of some systematists. Five are enumerated by the author, who follows Temminck.]

In others, which have hitherto been found in New Holland only, the tail is hairy to the tip.

[The author enumerates three, to which four have since been added by Mr. Ogilby, and an eighth by M. Geoffroy. These animals keep in holes of trees till twilight, and for an hour or two after sunset are observed eating the leaves of the different *Eucalypti;* also, in retired places, those with the young shoots of fruit-trees. The *Ph. vulpina* is known as the *Brush-tailed Opossum* in Van Diemen's Land, and the *Ph. Cookii,* as the *Ring-tailed Opossum.*]

THE PETAURISTS (*Petaurus,* Shaw ; *Phalangista,* Illig.)—

Have the skin of the flanks more or less extended between the legs, as in the Colugos, and Taguans among the Rodents, by which they are enabled to sustain themselves in the air for some seconds, and to make greater leaps. They have been found only in New Holland.

Some of the species still possess inferior canines, but extremely small. Their upper canines and the three first molars, both above and below, are very pointed; the back molars have each four points [the last excepted, in which there are but three]. M. Desmarest has named this division *Acrobates.* [It possesses thirty-six teeth in all.]

The Pygmy Petaurist (*Did. pigmæa,* Shaw).—Of the colour and nearly the size of a Mouse; the hairs of the tail disposed very regularly on its two sides like the barbs of a feather.

Other species have no inferior canines, and the superior are very small. Their four back molars each present four points, but a little curved into a crescent, somewhat as observed in the Ruminants. Anteriorly, there are two above and one below, less complicated: this structure renders them still more frugivorous than any of the preceding. [Their teeth amount in all to thirty-four.]

The Great Petaurist (*Did. petaurus,* Shaw; *P. taguanoides,* Desm.)—Resembles the Tagaun and the Colugo in size: its fur is soft and thick, and the tail long and [not in those which I have seen] flattened: brown-black above, white underneath.

The Sciurine Petaurist (*Did. sciurea,* Shaw).—Ash-coloured above, white beneath, and smaller than the preceding; a brown line commencing on the muzzle and continued along the back: the tail tufted, and as long as the body, its posterior portion black. From the islands near New Guinea. [It is abundant along the south coast of New Holland. The teeth are forty in number, and exhibit considerable modification; hence this animal has been made a separate division of the *Belidea,* Waterh. There are but four true molars to each jaw, with comparatively blunt tubercles originally; three false molars and a middle-sized canine above, and four small flattened teeth below: the palate also is in this group perfect, whereas it is not so in the two others. Four or five species are known to possess these characters.

The remainder appertain to the same minimum group as *P. taguanoides.*]

Our third subdivision possesses the incisors and superior canines of the preceding. The two toes of the hind-foot are also similarly united; but the posterior thumbs and inferior canines are wanting. It contains but a single genus,

THE POTOROOS (*Hypsiprymnus,* Illig.),—

Which are the last animals of this family that retain any trace of the general character of the *Carnaria.* Their teeth are nearly the same as in the Phalangers, and they still have pointed canines above [which all but disappear in one species]. Their two middle upper incisors are longer than the rest, and pointed; the two inferior ones project forwards. They have anteriorly a long trenchant and dentelated molar, followed by four others, each with four blunt tubercles. What particularly distinguishes these animals, however, is their hind legs, which are very much longer in proportion than their fore ones, that have no thumbs, and the two first toes of which are joined as far as the nail; so that, at a first glance, it seems as though there were but three toes, the middle one having two nails. They often hop on their hind-feet, at which time they make use of their long and strong tail to support themselves. They have accordingly the form and habits of the Kangaroos, from which they only differ in possessing the superior canine. Their regimen is frugivorous, and the stomach large, divided into two sacs, and possessing several inflations; but their cœcum is moderate and rounded.

Only one species is known, the size of a small Rabbit, and of a mouse-grey colour, which is termed the Kangaroo-rat (*Macropus minor,* Shaw.) [Five or six others have since been discovered, two of which, inhabiting New Guinea, are remarkable for their arboreal habits, in reference to which their structure is slightly modified, the limbs being less unequal, and the great nails of their hind-feet curved: they do not, however, essentially differ from the others. One species is common in the interior of Van Diemen's Land].

The fourth subdivision differs only from the third in having no canines whatever.

THE KANGAROOS, (*Macropus,* Shaw; *Halmaturus,* Illig.),—

In which all the characters occur that we have assigned to the preceding genus, except that the upper

canines are wanting, and the middle incisors do not project beyond the others. The unequal size of the limbs is even more remarkable, so that they advance on all fours with difficulty and slowly, but make immense leaps on their hind-feet, the great nail of which (almost in the shape of a hoof) serves them likewise for defence, as, by supporting themselves on one foot and their enormous tail, they can inflict a severe blow with that which is at liberty.* They are very gentle, herbivorous animals, their grinders presenting only transverse ridges: they possess five in all, of which the anterior are more or less trenchant, and fall with age, so that older individuals have often only three. Their stomach is formed of two elongated sacs, that are inflated at several places like a colon: the cœcum also is large and inflated. The radius allows a complete rotation of the fore-arm.

The penis in these two genera is not bifurcated; but the female organs are similar to those of other *Marsupiata*.

Fig. 43.—Great Kangaroo.

The Great Kangaroo (*M. major*, Shaw).—Sometimes six feet in height, being the largest animal of New Holland. It was discovered by Cook in 1779, and is now bred in Europe. The flesh is said to resemble venison. The young ones, which are only an inch long at birth, remain in the maternal pouch even when they are old enough to graze, which they effect by stretching out the neck from their domicile, when the mother herself is feeding. These animals live in troops, conducted by the old males.† They make enormous leaps. [Numerous other species are now known, which have even been arranged into subgenera: these, however, are not generally adopted. They degrade in size to smaller than a Hare.]

The fifth subdivision has two long incisors in the lower jaw, but no canines; in the upper two long middle incisors, with some small ones [four in number] placed laterally, and two small canines. It comprehends but one genus,

THE KOALA (*Koala*, Cuv.; *Lipurus*, Goldf.; *Phascolarctos*‡, Blainv.),—

Which presents a short, stout body, and short legs, without any [or rather with a short] tail: their anterior toes, five in number, separate into two groups for prehension, the thumb and index antagonizing with the other three. On the hind-feet there is no thumb; and the first two toes are united as in the Phalangers and Kangaroos. [There are five molars in each jaw, square, with four tubercles each, excepting the first. This animal is essentially a Phalanger with a short tail.]

One only is known (*Lip. cinereus*, Goldfuss.)—Of a greyish colour, which passes its life partly upon trees, and partly in burrows which it excavates at their foot (fig. 44.) The female carries her young for a long time on her back.

Fig. 44.—Koala.

Finally, our sixth division of the Marsupial animals, consisting of

THE WOMBAT (*Phascalomys*, Geof.; [*Amblotis*, Bass]),—

Comprehends a true Rodent according to the teeth and intestines, which preserves its relationship with the *Carnaria* only in the mode of articulation of its lower jaw; and which, in a rigorous system, it

* A Kangaroo will hug a Dog with its fore-paws, while it kicks and rips up the belly with its hind-foot.—ED.

† It appears rather that the animals of this genus are not strictly gregarious, but collect accidentally at the scattered feeding places. They lodge during the day among high ferns, and feed chiefly by night, or in the evening and morning; but are very harp-sighted during the day.—ED.

‡ This term is generally adopted. —ED.

would therefore be necessary to rank among the *Rodentia*. We should even have placed it there, had we not been gradually led to it by an uninterrupted series from the Opossums to the Phalangers, thence to the Kangaroos, and from the Kangaroos to the Wombat.* Their reproductive organs are entirely similar to those of other *Marsupiata*.

They are sluggish animals, with large flat heads, and bodies that appear as if crushed. They are without a tail; have five nails on each of the fore-feet, and four, with a small tubercle in place of a thumb, on each of the hind ones, all very long and adapted for burrowing. Their gait is remarkably slow. They have two long incisors to each jaw, almost similar to those of the *Rodentia*, [but which oppose flat surfaces to each other, and not chisel-like edges, as in the latter]; and their grinders have each two transverse ridges.

They subsist on herbage, and have a large and pear-formed stomach, and short and wide cœcum, furnished (like that of Man and the Ourang-outang) with a vermiform appendage. The penis is forked, as in the Opossums.

One species only is known (*Did. ursina*, Shaw); of the size of a Badger; the fur abundant, and of a more or less yellowish-brown. It is found in Van Diemen's Land, where it lives in its burrow; and breeds readily in confinement. The flesh is said to be excellent. [The skin of this animal is remarkably thick, and curiously attached to the hip-bones: its eyes are unusually small. When attacked, it grunts like a Pig; and is found at various elevations, burrowing in the forests and low grounds, and retiring to crevices in the upper. To the colonists, it is generally known as the *Badger*.

The *Marsupiata* are distributed by Prof. Owen, in conformity with the structure of their digestive organs, as follows:—

1. The cœcum altogether absent.—*Thylacynus, Dasyurus, Phascogale,* and probably *Myrmecobius.*
2. With a small cœcum.—*Didelphis* and *Cheironectes; Perameles,* and probably *Thylacomys.*
3. Cœcum of large size.—*Phascolarctos, Phalangista, Petaurus.*
4. The stomach complicated.—*Macropus* and *Hypsiprymnus.*
5. Cœcum with a vermiform appendage.—*Phascalomys*

This arrangement appears to be perfectly in accordance with the affinities of these animals: though, at the same time, it may be added that the Wombat (*Phascalomys*) might properly form a distinct order of *Ovovivipera*.]

THE FIFTH ORDER OF MAMMALIANS.

RODENTIA.

We have just seen, in the Phalangers, canines so small, that we can hardly consider them as such. The nutriment of these animals, accordingly, is chiefly derived from the vegetable kingdom. Their intestines are long, and the cœcum simple; and the Kangaroos, which have no canines at all, subsist on vegetables only. The Wombat might commence that series of animals of which we are now about to speak, and which have a system of manducation even less complete.

Two large incisors in each jaw, separated from the molars by a wide interval, cannot well seize a living prey, or devour flesh. They are unable even to cut the aliment; but they serve to file, and by continued labour, to reduce it into small particles; in a word, to *gnaw* it: hence the name *Rodentia* applied to the animals of this order: it is thus that they suc-

* This gradation is, however, more apparent than real, as regards the Wombat, which differs from all other *Marsupiata* in the persistency of the formative pulps of its teeth, which, in consequence, never cease growing at the base, as their crowns wear away by attrition.—ED

cessfully attack the hardest substances, frequently feeding on wood and the bark of trees. The better to accomplish this object, these incisors have enamel only in front, so that their posterior edges wearing away faster than the anterior, they are always naturally sloped [or chisel-like]. Their prismatic form causes them to grow from the root as fast as they wear away at the tip [their formative pulps being persistent]; and this tendency to increase in length is so powerful, that if either of them be lost or broken, its antagonist in the other jaw, having nothing to oppose or comminute, becomes developed to a monstrous extent.* The inferior jaw is articulated by a longitudinal condyle, in such a way as to allow of no horizontal motion, except from back to front, and *vice versâ*, as is requisite for the action of gnawing. The molars also have flat crowns, the enamelled eminences of which are always transversal, so as to be in opposition to the horizontal movement of the jaw, and better to assist in trituration.

The genera in which these eminences are simple lines, and the crown is very flat, are more exclusively frugivorous; those in which the eminences of the teeth are divided into blunt tubercles are omnivorous; while the small number of such as have no points more readily attack other animals, and approximate somewhat to the *Carnaria*.

The form of the body in the *Rodentia* is generally such, that the hinder parts of it exceed those of the front; so that [with the exception of a large South American group, including the Guinea-pig and its allies,] they rather leap than run. In some of them, this disproportion is even as excessive as in the Kangaroos.

The intestines of the *Rodentia* are very long; their stomach simple, or but little divided; and their cœcum often very voluminous, even more so than the stomach. In the subgenus *Myoxus*, however, this intestine is wanting.

Throughout the present group, the brain is almost smooth and without furrows: the orbits are never separated from the temporal fossæ†, which have but little depth: the eyes are directed sideways: the zygomatic arches, thin and curved below, announce the feebleness of the jaws; and the fore-arms have almost lost the power of rotation, their two bones being often united: in a word, the inferiority of these animals is perceptible in most of the details of their organization. Those genera, however, which have stronger clavicles, display a certain degree of address, and employ their fore-feet together to hold up food to the mouth: some of them even climb trees with facility.

[We have seen that in the true Lemurs the middle superior incisors are separated by a wide interval, which in the Colugos (*Galeopithecus*) is still more extended: in *Propithecus* of Mr. Bennett, on the contrary, the front pair are brought nearly contiguous, having more of the Monkey character than in other *Strepsirrhini*. The lower canines also, which are directed horizontally forward throughout that group, and approximated so as to leave little room for the intervening incisors, which are accordingly extremely narrow or compressed, are even more approximated in the *Propithecus*, so that one pair of the incisors is necessarily sacrificed; and hence the diminution of the interspace between the upper incisors. Now in this we may discern a slight approach to the rodent character of *Cheiromys*, in the loss of one pair of incisors. In the latter genus, the whole of the incisors disappear, the canines of both jaws occupying their site: precisely as in the true *Rodentia*, wherein also the incisors and not the canines or tusks are almost without exception obliterated, as is beautifully shown in the instance of the Hare, where true incisors exist posterior to the upper gnawing teeth: it will be observed that in all *Rodentia* the currently reputed incisors *pass through* the intermaxillaries; while the constant limitation of their number to two in each jaw, and the invariable absence of any trace of other teeth in the ordinary position of canines, assist in confirming the opinion here decidedly entertained respecting the nature of what have been designated incisive teeth in these animals. It may be added that the *Marsupiata* do not, therefore, as

* We have seen one of these upper teeth thus prolonged, and gradually curling round, so as to destroy the eye of a Rat.—ED.

† They are so in *Cheiromys*, ranged by the author in this order.—ED.

arranged by Cuvier, effect a transition in the rudimental character of their dentition from the *Carnivora* to the *Rodentia;* inasmuch as the *canines*, and not the incisors, disappear in them (as observable in *Hypsiprymnus*): the Wombat (*Phascalomys*) might indeed be thought to present a solitary exception to this remark; but there is reason to believe that the gnawing teeth of this animal are modified incisors. Perhaps the nearest *affinity* of the *Rodentia* is with the Elephant, among the *Pachydermata*.]

Some of the *Rodentia* even ascend trees with facility. Such are

THE SQUIRRELS (*Sciurus*, Lin.),—

Which may be recognized by their very compressed lower incisors, and by their long bushy tail. Their fore-feet have only four toes, the hinder five: the site of the anterior thumb is however marked by a tubercle [and it is between these tubercles of the two fore-paws that the Squirrels and allied genera hold up their food to the mouth]. They have in all four grinders to each jaw, variously tuberculated, and a very small additional one above in front, which soon falls. Their head is large, the eyes prominent and lively. They are light and agile animals, which nestle on trees, and subsist upon their produce.

THE SQUIRRELS, properly so called (*Sciurus*, Cuv),—

Have the hairs on the tail directed laterally, so as to resemble a feather. There are numerous species on both continents.

The Common Squirrel (*Sc. vulgaris*, L.)—[Bright red in summer, with a dash of grey on the upper parts in winter, at which latter season the fur is much finer, and the ears are terminated with long hairs; the belly white.] One of the most beautiful is the

Sc. maximus and *macrourus*, a native of India.—Nearly the size of a Cat; above, black, the flanks and top of the head a beautiful bright maroon, the head, and all the under parts of the body, with the inside of the limbs, pale yellow; a maroon-coloured band behind the cheek. It inhabits the palms, and is extremely fond of the milk of the cocoa-nut.

There are several species in warm climates, remarkable for the longitudinal bands which adorn their fur. Such are the Palmist [which has been known to vary entirely black, or white, &c. Certain African species, inhabiting rocky situations, the tail of which is not bushy, but thinly covered with stiff appressed hairs, and somewhat tufted at the extremity, constitute the *Petromys* of Smith and others, also from Africa, which are entirely covered with coarse rigid fur, the claws of which also are long and straight, adapted for burrowing only, compose the *Xerus*, Emp., and Ehr.; *Geosciurus*, Smith: many of the latter animals live together, in holes of the ground; subsisting mainly on roots, for which they scratch up the soil. *Sc. capensis*, Thunberg, is an example of this form.]

It is probable that we shall have to separate from the Squirrels certain species that have cheek-pouches, like the Hamsters, and which retreat into subterraneous holes. They are

THE GROUND-SQUIRRELS (*Tamia*, Illig.).

Such are

The *Sc. striatus*, Lin., which is found throughout northern Asia and America, particularly in the pine forests. The tail is less bushy than in the Common Squirrel of Europe, the ears smooth, and fur brown, with five black stripes and two white ones. [Those from America are specifically different, and indeed constitute two or three separate species.]

We ought also, most probably, to distinguish

THE GUERLINGUETS [(*Macroxus*, Bodd.)],—

Wherein the tail is long, and almost round, and the scrotum pendent and enormous. In both the Ground-squirrels and Guerlinguets, the teeth are similar to those of the true Squirrels.

Species of them occur on both continents.

THE TAGUANS, ASSAPANS, or Flying Squirrels, (*Pteromys*, Cuv.)—

Have already been separated. In these the skin of the flank, extending between the fore and hind legs, imparts the faculty of sustaining themselves for some instants in the air, and of making immense leaps. Their feet have long osseous appendages, which support a portion of this lateral membrane.

There is a species in Poland, Russia, and Siberia (*Sciurus volans*, Lin.)—Greyish ash-colour above, white below; the tail only half the length of the body: size of a Rat; and which lives solitarily in the forests. Another in North America, smaller, with the tail only a fourth shorter than the body (*Sc. volucella*, Lin.): it lives in troops the prairies of the more temperate districts.

In the Indian Archipelago there is one nearly the size of a Cat (*Sc. petaurista*, Lin.): but the same Archipelago produces smaller ones, as the *Sc. sagitta*, distinguished from the rest, the small ones especially, by its membrane, which, as in *Pt. petaurista*, forms an acute projecting angle behind the tarsus.

[M. F. Cuvier has subdivided this group into the Taguans (*Pteromys*), and Assapans (*Sciuropterus*), which latter term he applies to the smaller species, the hairs on the tail of which are arranged distachously: there are several eastern species, however, which appear to connect the two together.]

THE AYE-AYE (*Cheiromys*, Cuv.),—

The inferior incisors of which are still more compressed, and above all, more extended from front to back, resembling plough-shares. Their feet have each five toes, of which four of the anterior are excessively elongated; the medius being much more slender than the others; in the hind-feet, the thumb is opposable to the other digits; so that in this respect these animals are to the other rodents, what the Opossums are among the *Carnaria*.* The structure of their head is otherwise very different from that of the other *Rodentia*, presenting a closer relationship with the *Quadrumana* [among which this remarkable genus is now ranged by almost general consent. It is, in fact, in the aggregate of its conformation, a Lemurine animal: in which group we have already seen that the lower canines are singularly modified, projecting forwards, and being approximated to each other; insomuch that the intervening incisors (except in *Galæopithecus*) are consequently extremely compressed and narrow, one pair of them being even sacrificed in the Indris. In the present genus, the whole of the incisors disappear, as in the ordinary *Rodentia*; the canines of both jaws occupying their site: but it is very doubtful whether, as in the true Rodents, these teeth have persistent formative pulps, as there does not exist another known instance of continuously growing teeth in any animal pertaining to the great divisions of *Primaria* and *Carnaria*.† What little is known of the osteology of *Cheiromys* is strictly Lemurine; and no rodent possesses the rotation of the bones of the fore-arm, and free separate movement of the limbs as prehensile instruments, which are observed in this genus. Its habitat even is Madagascar, the metropolis of the Lemurine group of animals.]

Fig 45.—The Aye aye.

One species only is known, discovered by Sonnerat (*Sciurus madagascariensis*, Gm.); as large as a Hare, of a brown colour, tinged with yellow; tail long and thick, with some black bristles; and large naked ears. It is a nocturnal animal, the movements of which seem painful to it; lives in burrows, and employs its long slender digit to convey food to its mouth.

Linnæus and Pallas have brought together in one single group, under the general name of

RATS (*Mus*, Lin.),—

All the rodents possessed of clavicles which they could not distinguish by some obvious external character, such as the tail of the Squirrels or that of the Beaver; from which resulted the utter impossibility of assigning to them any common character: the greater number had merely pointed lower incisors, but even this character was subject to exceptions.

Gmelin has already separated the Marmots, Dormice, and Jerboas; but we carry their subdivision much further, from considerations founded on the form of their grinders.

THE MARMOTS (*Arctomys*, Gm.)—

Have, it is true, the inferior incisors pointed, as in the greater number of animals comprised in the great genus of Rats; but, as in the Squirrels [to which superior group they indubitably appertain], they have five molars on each side above, and four below, all of them sharply tuberculated; accordingly, some of the species are inclined to eat flesh, and feed upon insects as well as vegetables. They have four toes, and a tubercle in place of a thumb, to their fore-feet; and five toes to their hind feet. In other respects, these animals are nearly the direct reverse of the Squirrels; being heavy, with short limbs, a hairy tail of middle length or short, a large flat head, and they pass the winter in a state of

* The Opossums were arranged among the *Carnaria* in the author's first edition.—ED.

† The Wombat presents the only instance amongst the *Marsupiata*.

lethargy in deep holes, the entrance of which they close with a quantity of grass.* They live in society, and are easily rendered tame.

Two species are known in the Eastern continent. The Alpine Marmot (*Mus. alpinus*, Lin.), as large as a Rabbit, with a short tail, and yellowish-grey fur, more ash-coloured towards the head, which inhabits lofty mountains immediately below the perpetual snow line: and the Polish Marmot, or Bobac (*M. bobac*, Lin.), the same size as the other, and yellowish-grey, with a russet tint about the head; it inhabits the lesser mountains and hills from Poland to Kamtschatka, and often burrows in the hardest ground. Russian travellers in Bucharia mention some others, as *Arct. fulvus*, *leptodactylus*, and *musogaricus*, which are perhaps not sufficiently determined. America likewise produces several Marmots.

Under the name of

SOUSLIKS (*Spermophilus*, F. Cuv.),—

May be distinguished several Marmots which have cheek-pouches. Their superior lightness has caused them to be designated Ground-squirrels, [and they connect the true Squirrels with the foregoing]. Eastern Europe produces one,—

M. citillus, Lin.—A pretty little animal, of a greyish-brown, waved or mottled with white, the spots small, which is found from Bohemia to Siberia. It has a particular fondness for flesh, and does not spare even its own species. [There is another in Russia, *Sp. guttatus*, Tem., and more, further eastward, as *Sp. xanthoprymnus*, a native of Trebizond; but North America produces by far the greater number, some of which are beautifully marked with white lines along the back, between each of which is a series of white spots in the elegant *Sp. Hoodii*.]

It appears that we should approximate to the Marmots, a rodent remarkable for the habit of living in great troops, in immense burrows, which have even been styled villages. It is called the ***Prairie Dog*** or ***Barking Squirrel***, on account of its voice, which resembles the bark of a small Dog: the ***Arctomys ludovicianus*** of Say. M. Rafinesque, who [erroneously] ascribes to it five toes to each foot, has formed of it his genus *Cynomys*. [It is in every respect a true Marmot.

All the foregoing genera, with the prominent exception of *Cheiromys*, are simply modifications of a single peculiar type, and together compose the first principal section of the *Sciuridæ* or Squirrel family.]

THE DORMICE (*Myoxus*, Gm.)—

Have the lower incisors pointed, and four grinders, the crown of each of which is divided by closely-folded lines of enamel.

They are pretty little animals, with soft fur, a hairy and even tufted tail, and lively expression: they inhabit trees like the Squirrels, and subsist on their produce. In the very numerous order of rodents, this is the only subgenus which is destitute of a cœcum. They become torpid in winter, like the Marmots, passing that season in a very profound lethargy: and so natural is it for them to fall into this state, that a species from Senegal (*M. Coupeii*), which had probably never experienced it in its native country, became torpid in Europe as soon as it was exposed to cold.

The Fat Dormouse (*M. glis*, Lin.)—Size of a Rat; greyish ash-brown above, whitish underneath; of a deeper brown around the eyes; tail very hairy throughout its length, and disposed somewhat like that of a Squirrel, frequently also a little forked at its extremity. It inhabits the south of Europe, and nestles in the holes of trees and fissures of rocks. It sometimes attacks small birds. This is probably the *Rat* fattened by the ancients, among whom it was considered a great delicacy. [It is still eaten by the modern Italians.]

The Garden Dormouse (*M. nitela*).—Somewhat less than the preceding; greyish-brown above, white beneath; black round the eye, which extends spreading to the shoulder; the tail tufted only at the end, and black, with its extremity white. This species is common in gardens, where it shelters itself in holes about the walls, and does much injury to the fruit-trees nailed to them. [It does not occur in Britain.]

The Red Dormouse (*M. avellanarius*, Lin.)—Size of a Mouse; cinnamon-red above, white beneath; the hairs of the tail disposed somewhat like a feather. From the forests of all Europe. It constructs its nest of grass on low branches, in which it rears its young: the rest of its time, and particularly during winter, it remains in the hollows of trees.

[It has been said that this species cannot pierce a ripe nut-shell, and that its specific name does not correctly apply; but in confinement we have frequently seen it penetrate to the kernel of the hardest hazel-nuts.

THE GRAPHYURES (*Graphyurus*, F. Cuv.)—

Scarcely differ from the Dormice externally, but have weaker jaws, and a longer and more slender intestinal canal: their molars are of small size, and simple structure; and they have also no cœcum to the intestine.

* The Ground-Squirrels (*Tamias*), and even the members of the restricted group *Sciurus*, are more or less subject to become torpid in winter.—ED.

Two species have been ascertained, both from South Africa.

The Dormice and Graphyures compose the second and last division of the *Sciuridæ* or Squirrel family]. We approximate to the Dormice, [but with questionable propriety],—

THE ECHYMYDS (*Echymys*, Geof.; *Loncheres*, Illig.),—

Which also have four grinders, but differently formed; the superior consisting of two laminæ bent like a V, the inferior of one bent and one simple lamina. The fur of several species is rough, with intermixed flattened spines or prickles. They inhabit America. One of them,

The Golden-tailed Echymyd (*Hystrix chrysuros*, Schreb.), is more than double the size of the Brown Rat; it is a handsome animal, of a brown maroon-colour, the belly white, with a crest of elongated hairs and a longitudinal white band on the head; the tail long, and black, with its posterior half yellow. From Guiana. Another,

The Red Echymyd (*Ech. rufus*; the *Spinous Rat* of Azzara), of the size of a Rat, reddish-grey, with tail shorter than the body, is found in Guiana, Brazil, and Paraguay. It excavates long subterraneous burrows. [These species with hairy tails pertain to the *Nelomys* of M. Jourdan, who restricts the term *Echymys* to the following.]

Others have merely the ordinary kind of hair, more or less rough.

The most remarkable is *Ech. dactyliacus*, Geoff., the Long-toed Echymyd, which is still larger than the Golden-tailed species, and has the two middle toes of the fore-feet double the length of the lateral ones: its scaly tail is longer than the body fur yellowish grey; the hairs on the nose forming a crest directed in front.

The *Mus paradoxus*, Thomas (*Lin. Trans.* xi., *Heteromys*, Lesson), apparently differs only from the Echymyds in possessing cheek-pouches. However, not having seen its teeth, I cannot arrange it.

[THE CERCOMYDS (*Cercomys*, F. Cuv.)—

Are closely related to the preceding, and have also four molars surrounded with enamel, which are deeply indented internally, and inclose three insulated circlets of enamel near their external border: their form is still more Rat-like, but with the profile of the visage arched; there are no spines in the fur, and the tail is long and scaly.

One species (*C. braziliensis*) is figured by M. F. Cuvier in his great work on Mammalia].

THE HYDROMYDS (*Hydromys*, Geof.)—

Are in many respects related to the Echymyds externally; but they are distinguished from all other Rats by their hind-feet, two-thirds of which are palmated: their molars, also, two in number above and below, have a peculiar character in the crown, which is divided into obliquely quadrangular lobes, the summits of which are hollowed out like the bowl of a spoon. They are aquatic.

Several have been sent to Europe from Van Diemen's Land, some with the belly white, others with a fulvous belly, but all deep brown above, with a long tail which is black at the base, the distal half white. They are sometimes double the size of the Brown Rat. *H. hydrogaster* and *H. leucogaster*, Geof. [The former is variable, but the latter notwithstanding appears to be another species.]

THE HOUTIAS (*Capromys*, Desm.)—

Have four molars above and below, with flat crowns, the enamel of which is folded inward, so as to form three re-entering angles on the external border, and only one on the internal side of those above, and the inverse in the lower ones. Their tail is round, and slightly hairy. Like the Rats, they have five toes to their hind feet, and four with the rudiment of a thumb to the anterior; their form is that of Rats as large as a Rabbit or Hare.

Two [three] species are known [all from the West Indies], which, together with the Agoutis, formerly constituted the chief game of the indigenous inhabitants. *Isodon pilorides*, Say, refers to one of them. [They are not distantly allied to the Porcupines. It is remarkable that these animals hold up their food (a fusiform root for instance) with one foot only to the mouth, resting on the other three. They ascend bushes with facility.]

THE RATS, properly so called, (*Mus*, Cuv.),—

Have three molars to each jaw, the anterior of which is the largest [and the posterior smallest], and the crowns of which are divided into blunt tubercles, which, by attrition, acquire the form of a disc variously indented; their tail is long and scaly. These animals are very annoying from their fecundity, and the voracity with which they gnaw and devour substances of every kind. There are three species very common in houses, namely,

The Common Mouse (*M. musculus*, Lin).—Known in all times and all places.

The Black Rat (*M. rattus*, Lin.), which the ancients have not alluded to, and which appears to have entered Europe during the middle ages. It is more than double the size of the Mouse in all its dimensions. The fur is blackish [with the ears much larger, and the tail longer, than in the following. There is a brown variety of this species, which is common in Paris, and appears to have been figured by M. F. Cuvier as the Surmulot.]

The Brown Rat, or Surmulot (*M. decumanus*, Lin.), which did not pass into Europe till the eighteenth century, and is now more common in large cities [and elsewhere, except in remote isolated localities,] than the Black Rat itself; it is a fourth larger than that species, and is also distinguished by its brown colour. This animal appears to belong to Persia, where it lives in burrows: it was not till 1727, that, after an earthquake, it arrived at Astracan, by swimming across the Volga.

It would seem that the Black Rat, also, originated in the East; and these two large species, together with the Mouse, have been transported in ships to all parts of the globe.

[Of the very numerous others, it must suffice to name the huge Bandicoot Rat of India (*M. giganteus*, Hardw.), which is much larger than the Surmulot. Those indigenous to South America have more complicated folds of enamel to their molars.*] Some have spines mingled with their fur, as

The Cairo Mouse (*M. cahirinus*, Geoff.), which has spines on the back in place of hairs, and was noticed by Aristotle.

[Only two strictly indigenous British Mice have hitherto been described: the first, extremely diminutive, is the Harvest Mouse (*M. messorius*, Shaw), with short ears, and red fur similar to that of the Common Dormouse: it constructs a beautiful round or pear-shaped nest, attached to corn-stems, or placed in low bushes; and is remarkable for its tail being slightly prehensile at the extremity. The second is commonly termed the Long-tailed Field Mouse (*M. sylvaticus*), and might almost form a separate subgenus; it rather exceeds the common Mouse in size, with proportionately larger ears, and much larger and very brilliant eyes; a brown mark in the centre of the chest: it is a pretty and very active species, more generally diffused than the Harvest Mouse, and never enters buildings, where the other is often carried with the sheaves.]

Warm climates produce Rats, similar in every detail to those of which we have just spoken, except that their tails are more hairy. Such are

Hypudæus variegatus, Licht., var. *flava; Meriones syenensis*, Id. To which must be added the *Arvicola messor*, Le Conte; *Arv. hortensis*, Harl., or *Sygmodon*, Say, distinguished however by its hairy ears, like the *Otomys*.

Another group, also with a hairy tail, but the teeth of which wear away faster, comprises the *Hypudæus obesus*, Licht., the *Mus ruficaudus*, Id., and also the *Meriones sericeus* of the same naturalist, characterized by the projecting ridges of the molars, which alternately catch in each other.

We have then to group the *Neotoma floridanum* of Say, or the *Arvicola floridana* of Harlan, and the *Arvicola gossypina*, Le Conte, two species which, size excepted, are very similar even in their colours, and the molars of which, provided with roots [after a while], when worn a little, have crowns similar to those of the *Arvicolæ*. [The tail in one of them is covered with hair of tolerable length. Both inhabit North America.

Reithrodon, Waterh., requires also to be introduced here, distinguished by its grooved upper incisors, its arched and Rabbit-like head, great eyes, and large and round ears. Three or four species are known, from South America, where they were discovered by Mr. Darwin.

The *Pseudomys* of Gray is another Rat-like animal, remarkable for inhabiting New Holland: the anterior molar of its lower jaw is however more compressed and elongated, and there is a claw on its rudimentary thumb. The species, *Ps. australis*, inhabits holes in swampy places, at Liverpool plains.

It is necessary also to introduce here the *Hapalotis albipes*, Licht.; *Conilurus constrictus*, Ogilby; another rodent from New Holland, the size of a Rat, with delicate ample ears, and a long, hairy, and somewhat tufted tail. It is remarkable for constructing an above-ground habitation, so firmly interlaced with thorny twigs externally, as to repel the Dingo or semi-wild Dog of that country.]

THE GERBILS (*Gerbillus*, Desm.; *Meriones*, Illig.)—

Have molars scarcely differing from those of the Rats, merely becoming sooner worn, so as to form transverse ridges. Their upper incisors are furrowed with a groove; their hind feet are somewhat longer in proportion than those of Rats in general, with the thumb and little toe but slightly separated: their tail is [very] long and hairy, [and generally tufted].

The sandy and warm parts of the eastern continent produce several species, [mostly of a light buff colour, white underneath].

THE MERIONS (*Meriones*, F. Cuv.),—

Which we separate from the Gerbils, have the hind feet still longer, the tail nearly naked, and a very small tooth before the superior molars; characters which approximate them to the Jerboas: their superior incisors are grooved, as in the Gerbils, and their toes also are similar.

There is a small species in North America, *Mus canadensis*, Pen.; *Dipus canadensis*, Shaw; *D. americanus*.

* Certain of these, the upper lip of which is scarcely fissured, compose the *Holochilus*, Brandt. There are also some arboreal Mice in South Africa, which constitute the *Dendromys* of Smith: they scarcely differ in structure from the British Harvest Mouse.—ED.

Barton. Its agility is extreme, and it closes itself up within its burrow, and passes the winter in a state of lethargy. The *Gerbillus labradorius*, Harl., or *Mus labrad.*, Sabine, constitutes another.

THE HAMSTERS (*Cricetus*, Cuv.)—

Have teeth nearly similar to those of the Rats, but their tail is short and hairy, and the two sides of their mouth are hollowed (as in certain Monkeys) into sacs or cheek-pouches, in which they transport the grain they collect to their subterraneous abodes.

The Common Hamster (*Mus cricetus*, Lin.).—Larger than the Rat, of a reddish-gray above, black on the flanks and underneath, with three white spots on each side; its four feet are white, and there is also a white spot under the throat, and another under the breast; some individuals are all black. This animal, so agreeably variegated in colour, is one of the most hurtful in existence, on account of the quantity of grain which it hoards up, filling its hole, which is sometimes seven feet in depth. It is common in all the sandy districts, that extend from the north of Germany to Siberia. The latter country produces several smaller species.

THE VOLES (*Arvicola*, Lacep.)—

Have three grinders above and below, like the Rats, but without roots, and which are each formed of triangular prisms, placed alternately in two lines. [Their incisors (or *tusks*), unlike those of the preceding genera, are rounded, having an oval section.] They require to be subdivided into several groups, viz.:—

THE MUSKQUASH (*Fiber*, Cuv.; [*Ondatra*, Laceped.]),—

Which is a Vole with semi-palmated hind-feet, a long, scaly, and compressed tail, of which one species only is well known,—

The Ondatra, *Muskquash*, or *Musk Rat* of Canada (*Castor zibeticus*, Lin.; *Mus zibeticus*, Gm.)—As large as a Rabbit, and reddish grey [the fur resembling that of the Beaver]. In winter they construct, on the ice, a hut of earth, in which several reside together, passing through a hole in the bottom, for the roots of the *Acorus* on which they feed. When the ice closes their holes, they are necessitated to devour one another. This habit of building has induced some authors to refer the Muskquash to the genus *Castor*.

The second subdivision is that of

THE ORDINARY VOLES (*Arvicola*, Cuv.; *Hypudæus*, Illig.),—

The tail of which is hairy, and about the length of the body [or shorter], without webs to the toes.

The Water Vole (*Mus amphibius*, Lin.)—A little larger than the Black Rat, and deep greyish-brown; the tail as long as the body. Inhabits the banks of ditches, and burrows in marshy plains in search of roots; but it swims and dives badly. [This species has been known to occasion much damage, by burrowing into the raised banks of canals: in other respects it is quite harmless, except that it lays up a store of potatoes, &c., in its winter retreat, which is placed far from the water. Its ordinary food is green aquatic herbage. A black variety is not of uncommon occurrence, in many parts of Britain.]

The Alsacian Vole (*Mus terrestris*, Lin.)—Rather smaller than the last, with a shorter tail. It lives under ground like the Mole, preferring elevated fields, where it excavates galleries, and removes the earth to some distance from the opening. Its magazines, which are principally filled with the roots of the wild carrot cut into two-inch pieces, are frequently two feet in diameter. [It is not found in Britain.]

Meadow Vole (*Mus arvalis*, Lin.).—Size of a Mouse, reddish ash-colour, the tail a little shorter than the body. It inhabits burrows in the fields, in which it hoards up grain for the winter. By multiplying excessively, it sometimes occasions great damage. [There are several nearly allied small European species, two of which inhabit Britain: that known as *A. arvalis* in this country has the tail very short, and the ears inconspicuous; *A. pratensis* or *ripicola* is redder, with a longer tail, and more apparent ears; it is less common than the other. Many more exist in Asia and North America, of which it will be sufficient to notice]

The Economic Vole (*Mus œconomicus*, Pallas.)—A little darker coloured than the foregoing, with the tail still shorter. It inhabits a sort of oven-shaped chamber, placed under the turf, from which issue several narrow and ramifying canals running in various directions; other canals communicate with a second cavity, wherein it amasses its provisions. From all Siberia. It is thought to have been also found in Switzerland and the south of France, particularly in the potato fields.

THE LEMMINGS (*Georychus*, Ill.; [*Lemmus*, Link]),—

Have exceedingly short ears and tail, and fore-feet better adapted for digging. [In other respects, they only differ from the Voles in being rather more heavily formed.]

The two first species have five very distinct nails to their fore-feet, as in the Mole-rats and Helamyds.

The Scandinavian Lemming (*Mus lemmus*, Lin.)—A northern species, the size of a Rat, with fur variegated black and yellow: it is very celebrated for its occasional migrations in immense bodies. At these periods they are said to march in a straight line, regardless of rivers or mountains; and while no insurmountable obstacle impedes their

progress, they devastate the country through which they pass. Their ordinary residence appears to be the shores of the Arctic Ocean.

The Siberian Lemming, or Zocor (*Mus aspalax*, Gm.)—Reddish-grey; the three middle nails of the fore-feet long, arcuated, compressed and trenchant, for cutting earth and roots. The limbs are short; there is scarcely any tail; and the eyes are exceedingly small. From Siberia, where it lives under-ground, like the Moles and Mole-rats, and subsists chiefly on the bulbs of different *Liliaceæ*.

The third species, like the other animals comprehended under the great genus of Rats, has only the rudiment of a thumb to its fore-feet. It is the Hudson's Bay Lemming (*Mus Hudsonicus*, Gm.); of a pearl-grey colour, without any tail or external ears: the two middle toes of the fore-feet of the male seem to have double claws, the skin at the end of the toe being callous, and projecting from under the nail; a variety of conformation unknown except in this animal.* It is as large as a Rat, and lives under ground in North America.

THE OTOMYDS (*Otomys*, F. Cuv.; [*Euryotis*, Brandt])—

Are nearly allied to the Voles, and have also three grinders, but composed of slightly arcuated laminæ, which are arranged successively in file, so as to present an exact miniature resemblance to the grinders of the Elephant. Their incisors are grooved longitudinally, and the tail and ears are hairy, the latter being also large.

The only known species, the Cape Otomyd (*O. capensis*, F. Cuv.), inhabits Africa, and is of the size of a Rat, with fur annulated black and fulvous. Tail a third shorter than the body.

THE JERBOAS (*Dipus*, Gm.)—

Have nearly the same teeth as the Rats properly so called, differing only in the occasional presence of a very small tooth, placed before the superior molars. Their tail is long and tufted at the end, the head large, and eyes large and prominent; but their principal character consists in the immoderate length of the hinder limbs, as compared with the anterior, and above all, in the metatarsus of the three middle toes, which is formed of a single bone, as in what is termed the tarsus of birds. This disproportion of the limbs caused them to be designated *two-footed Rats* by the ancients: and in fact their ordinary gait is by great leaps on the hind-feet. Their fore-feet have each five toes; and in certain species, besides the three great ones to the hind-feet, there are [one or two] small lateral toes. These rodents live in burrows, and become profoundly torpid in winter.

[There are numerous species, inhabiting Asia and Africa. Those with five toes have been brought together by some under the name *Alectaga*.]

THE HELAMYDS (*Helamys*, F. Cuv.; *Pedetes*, Ill.),—

Which are commonly termed *Jumping Hares*, have, like the Jerboas, the head large, as are also the eyes, a long tail, and very short fore-legs in comparison with the hinder; the disproportion, however, being much less than in the true Jerboas. Their peculiar characters consist in having four grinders, each composed of two laminæ; five toes to the fore-feet, armed with long and pointed nails, and four only to the hind-feet, all separate, even to the bones of the metatarsus, and terminated by large claws almost resembling hoofs. The number of their toes is accordingly inverse to that of the ordinary Rats. Their inferior incisors are truncated, and not pointed as in the Jerboas, and as in the majority of other animals which have been comprised in the great genus of Rats.

One species only is known, as large as a Rabbit, and pale fulvous, with a long tufted tail black at the tip (*Mus caffer*, Pallas; *Dipus caffer*, Gm.)—It inhabits deep burrows near the Cape of Good Hope. [The affinities of this curious animal are by no means obvious.]

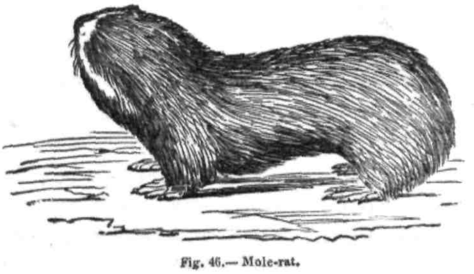

Fig. 46.— Mole-rat.

THE MOLE-RATS (*Spalax*, Guldenstedt)—

Have also been very properly separated from the genus of Rats, although their grinders are three in number, and tuberculated as in the Rats properly so called, and also the Hamsters, and are merely a little less unequal; their incisors being too large to be covered by the lips, and the extremities of those of the lower jaw

* The Plovers, and several other birds belonging to the same group, present a somewhat analogous conformation.—ED.

trenchant, rectilinear, and not pointed: their limbs are very short; all their feet have five short toes, with flat and slender nails; their tail is short or wanting, and there is no external ear. They live under ground like the Moles, throw up the earth in the same manner, although provided with very inferior instruments for the purpose, and subsist entirely on roots.

The Blind Mole-rat, Zemny, or Stepitz (*Mus typhlus*, Pallas.)—A singular animal, which, from its large head, angular at the sides, its short legs, the total absence of a tail or of any apparent eye, has a most shapeless appearance. The eye is not visible externally, and we merely find beneath the skin a small black globule, which appears to be organized like an eye, but which cannot serve for the purpose of vision, since the skin passes over it without opening, or even becoming thinner, and being as much covered with hair as on any other part. It exceeds our Rat in size, and has smooth ash-coloured fur, verging on red. Olivier supposed that this animal was alluded to by the ancients, when they spoke of the Mole as being totally blind.

The islands in the Straits of Sunda produce a Mole-rat as large as a Rabbit, of a deep grey colour, with a white longitudinal stripe upon the head (*Spalax javanicus*, Auct.)

[THE CANETS (*Rhizomys*, Gray; *Nyctocleptes*, Tem.)—

Have been approximated to the Mole-rats; but have small open eyes, and conspicuous naked ears: their head is large, the body round and massive; limbs short, with five toes to each foot, and thick and naked tail of mean length. There are three rooted molars on each side of both jaws, more complicated than in *Spalax*.

Two species are described, *Mus sumatrensis*, Raffles, which feeds chiefly on the roots of the bamboo, and *R. sinicus*, Gray.]

From the Mole-rats themselves should have been separated—

THE BATHYERGUES (*Bathyergus**, Ill.; *Orycteropus*, F. Cuv.),—

Which, with the general form, the feet, and truncated incisors of the preceding, combine four molars to each jaw: their eyes, though small, are distinctly perceptible; and they have a short tail.

The Shore Bathyergue (*Mus maritimus*, Gm.).—Nearly the size of a Rabbit, with grooved upper incisors, and whitish-grey fur. Also the Cape Bathyergue (*M. capensis*, Gm.), scarcely as large as a Guinea-pig, brown, with a spot around the eye, another round the ear, and a third on the vertex, together with the end of the muzzle, white. The incisors of this species are smooth. There is a third, also, with smooth incisors like the last, grey, and hardly equal in size to a Rat (*B. hottentotus*).

We should place near the Mole-rat and Bathyergues

THE PSEUDOSTOMES (*Geomys*, Rafinesque; *Pseudostoma*, Say; *Ascomys*, Licht.; [*Saccophorus*, Kuhl]),—

Which have likewise four molars above and below, prismatically compressed: the first double, the three others simple; and the upper incisors of which are furrowed with a double groove in front. Their three anterior middle nails, the medial more especially, are very long, crooked, and trenchant. They are low on the legs, and have very deep cheek-pouches, which open externally, enlarging the sides of the head and neck in a singular manner.

Only one species is known (*Mus bursarius*, Shaw), of the size of a Rat, with reddish-grey fur; the tail naked, and shorter by half than the body. It inhabits deep burrows, in the interior of North America. The figure of this animal in the *Linnæan Transactions* resembles nothing in nature, having the cheek-pouches turned inside out.

THE GAUFFRES (*Diplostoma*, Rafin.)—

Scarcely differ from the preceding, except in the total absence of a tail.

They are from North America. The species before us is reddish, and ten inches in length. [Eight or ten species pertaining to this and the preceding subdivision are now known, one or more inhabiting Europe.

THE SACCOMYDS (*Saccomys*, F. Cuv.)—

Have similar cheek-pouches, and four rooted molars on each side of both jaws, successively lessening. They have five toes on each foot, the anterior thumbs very small; tail long and naked.

The only species described (*S. xanthophilus*) inhabits North America, and is of the size and has much the aspect of a Mouse. Its cheek-pouches were distended with the flowers of *Securidaca volubilis*, with some entire seeds, apparently of *Convolvulaceæ*.

* This name is now confined to certain species which have only three molars. *Orycteropus*, however, is also applied to a genus of *Edentata*. —ED.

We now pass to larger rodents than those of which we have hitherto spoken, but of which several have still well-developed clavicles.

Of this number are

THE BEAVERS (*Castor*, Lin.),—

Which are distinguished from all other rodents by their horizontally-flattened tail, of a nearly oval form, and covered with scales. They have five toes on each foot, the hinder being webbed, and a double and oblique nail on the digit next the thumb. Their grinders, four in number above and below, with flat crowns, appear as if formed of a doubled bony fillet, exhibiting one deep indentation on their internal border, and three on the outer edge above, and the reverse below.

They are rather large animals, and are aquatic in their mode of life; their feet and tail assisting them in swimming. As they subsist chiefly on bark and other hard substances, their incisive teeth are very robust, and grow as rapidly from the root as they wear at the tip. By means of them they are enabled to cut down trees of various kinds.

Large glandular pouches, which terminate on the prepuce, secrete a pommade of very pungent odour, which is employed in medicine under the name of *Castoreum*. In both sexes, the organs of generation terminate within the extremity of the rectum, so that they have only one external orifice.

The Beaver of Canada (*C. fiber*, Auct.).—Surpasses the Badger in size, and is, of all quadrupeds, the most industrious in fabricating its dwelling; to erect which many work in concert, in the most retired districts of North America.

Beavers choose water of such a depth as is not likely to be frozen to the bottom, and, whenever possible, running streams, that the wood which they cut above, may be carried downwards by the current to where they require it. They maintain the water at an equal height, by dams constructed of branches of trees, mixed with clay and stones, and repair them year after year, till a hedge is at length formed by the germination of part of the materials. Each hut serves for two or three families, and is divided into two apartments; the upper dry, for the habitation of the animals; the lower under water, for the provision of bark. The latter only is open, having its entrance under water, without any communication with the land. The huts are formed of interlaced twigs and branches, having their interstices closed up with mud. There are always several burrows along the bank, in which these animals seek for refuge when their huts are attacked. They only inhabit them during the winter; dispersing in summer, at which season they live solitarily.

The Beaver is easily tamed, and accustomed to feed on animal substances. Those of Canada are of a uniform reddish brown; and their fur, as every one knows, is in much request for hatting. It is sometimes flaxen-coloured; at others black, or white. We have been unable to ascertain, on the most scrupulous comparison, whether the Beavers which inhabit burrows along the Rhone, the Danube, the Weser, and other rivers of Europe, are specifically different from those of America; and whether the vicinity of man prevents those of the eastern continent from building.

THE COYPU (*Myopotamus*, Commerson)—

Resembles the Beaver in size, in having four molars almost similarly compressed, in the robustness of its yellow-coloured incisors, and in having five toes to each foot, those of the hinder palmated; but its tail is long and rounded, [and its skull dissimilar].

We only know one (*Mus coypus*, Molina), which lives in burrows beside the rivers of South America. Its yellowish-grey fur, mixed with down at the root, is employed by hatters like that of the Beaver, and is consequently an important article of commerce. Thousands of their skins are sent to Europe. [This species, like the Beaver, is easily tamed, and appears to withstand the climate of this country.]

THE PORCUPINES (*Hystrix*, Lin.)—

Are recognized at the first glance by the stiff and pointed quills with which they are armed, somewhat as in the Urchins or Hedgehogs, among the *Carnaria*. Their grinders are four in number above and below, with flat crowns differently modified by lines of enamel, between which are depressed intervals. Their tongue is roughened by spiny scales. The clavicles are too small to rest on the sternum and scapular, being merely suspended by the ligaments. They live in burrows, and have very much the habits of Rabbits. From their grunting voice, and thick truncated muzzle, they have been compared to Pigs, whence their French name of *Porc-epin* or *Porcupine*.

THE PORCUPINES, properly so called (*Hystrix*, Cuv.), —

Have the head more or less convex, on account of the developement of the nasal bones. They have four toes before and five behind, furnished with stout claws.

That of Europe (*H. cristata*, Lin.) inhabits the South of Italy, Sicily, and Spain. Its quills are very long, and

annulated black and white; there is a crest of long bristles on its head and neck. Its tail is short, and furnished with hollow truncated tubes suspended by slender pedicles, which make a rattling sound when the animal shakes them. Its cranium and muzzle are singularly convex. There are other species not very different, but with the head less convex, inhabiting India and Africa. [These constitute the *Acanthion* of M. F. Cuvier: the *H. hirsutirostris*, Brandt, is however intermediate.]

We separate from the true Porcupines

THE ATHERURES (*Atherura*, Cuv.),—

The head and muzzle of which are not inflated, and the tail long, but not prehensile; their feet are similar to those of the preceding.

The Pencil-tailed Atherure (*Hyst. fasciculata*, Lin.)—The quills on the body furrowed with a groove in front, and the tail terminated by a bundle of flattened horny slips, constricted at intervals. [Inhabits India and Malacca.]

THE URSONS (*Erethizon*, F. Cuv.),—

Have a flat cranium, and short muzzle which is not convex: their tail is of middle length, and the spines short and half-hidden in the hair.

One species only is known, from [the Atlantic side of] North America (*Hyst. dorsata*, Lin.). [The *E. epixanthus*, Brandt, from the western side of the same continent, appears to be another. These animals produce but one young at a birth.]

THE COENDOUS (*Synetheres*, F. Cuv. [*Cercolabes*, Brandt]).

Muzzle short and thick; the head convex above; quills short; and the tail, in particular, long, naked at the tip, and prehensile, as in a Sapajou or Opossum. They climb trees, and have only four toes on each foot.

In the warm parts of North America, there is a species with black and white spines, and brown-black fur (*Hyst. prehensilis*, Lin.); and a smaller kind in South America (*H. insidiosa*, Licht.), the prickles of which are partly red or yellow, and hidden during part of the year by its long greyish-brown fur. [M. d'Orbigny is of opinion that these constitute but one species. In Brandt's memoir on the Porcupines, however, they are referred to different subgenera, after M. F. Cuvier; the first, with the addition of another (*S. platycentrotus*), to *Synetheres* as restricted, the other, with two more species (*S. nigricans* and *S. affinis*), to a subdivision *Sphiggurus*.

THE AULACODON (*Aulacodus*, Tem.)

Incisors very broad, the upper furrowed with two grooves, and a third at their inner margin: four molars as in the preceding, those of the upper jaw with a single deep fold of enamel within, and two without, excepting the anterior, which has three; in the lower jaw, the outer margin has only one fold, and the inner two. There are five toes before and four behind, and some flattened spines mingled with the fur. The form is that of a Rat, with the molars of a Porcupine.

A. swinderianus, Tem., is the only known species, from the Eastern Archipelago].

THE HARES (*Lepus*, Lin.)—

Have a very distinctive character, in their superior incisors being double; that is to say, there is another of small size behind each of them* [or, in other words, two genuine incisive teeth are present in these animals, posterior to the ordinary representatives of the tusks or canines]. Their molars, five in number above and below, are each of them formed of two vertical laminæ soldered together, and in the upper jaw there is a sixth, simple and very small. They have five toes before, and four behind; an enormous cœcum, five or six times the size of the stomach, and lined internally with a spiral layer throughout its whole length. The interior of their mouth and the under part of their feet are covered with hair like the rest of the body.

THE HARES, properly so called (*Lepus*, Cuv.),—

Are distinguished by their long ears, short tail, hind-feet much longer than the fore, imperfect clavicles, and antorbital space in the cranium widely pierced and reticulated. There are numerous species in both hemispheres, which from their resemblance are difficult to characterize.

[Four occur in the British islands. The Common Hare (*L. timidus*, Lin.), with yellowish-brown fur, which has a tendency to curl; the Irish Hare (*L. hibernicus*), with shorter limbs and ears, and smooth reddish fur, of very

* There is even a period when they are shedding their teeth, during which they appear to have three pair of upper incisors, one behind the other.

inferior value to that of the preceding, and which occasionally turns white in winter *; the Variable Hare (*L. variabilis*), a mountain species, larger than either of the foregoing, with still shorter ears and limbs than the Irish Hare, and brown fur in summer, which always changes to white at the approach of winter; and the Rabbit (*L. cuniculus*), remarkable for its burrowing habits, and for bringing forth its young blind and naked, while the Leverets of the three others see and run from birth. Not less than sixteen species of *Lepus* are already known in North America; and many others exist in Asia and Africa.]

THE PIKAS (*Lagomys*, Cuv.)—

Have ears of moderate length, the limbs nearly equal, the antorbital foramen simple, almost perfect clavicles, and no tail whatever. They often utter a very sharp cry. They have hitherto been found only in Siberia [since, however, at a considerable altitude on the Himmalayas, and in North America], and Pallas was the first to make them known.

[The largest of them] *Lepus alpinus*, Pallas, is the size of a Guinea-pig, and yellowish-red. It inhabits the most elevated mountain summits, where it passes the summer in selecting and drying the herbage for its winter provision. Its hay-stacks, which are sometimes six or seven feet high, are a valuable resource for the Horses of the Sable-hunters.

Some fossil remains have been discovered of an unknown species of Pika, in the accumulations of osseous breccia in the island of Corsica.

After the two genera of Porcupines and Hares, come the rodents which Linnæus and Pallas brought together under the name of *Cavia*, but for which it is impossible to assign any other constant and positive character than the imperfection of their clavicles, though the various species are not without analogy in the aspect of their body and manners. They are all from the New Continent.

THE CAPYBARA (*Hydrochærus*, Erxleben)—

Has four toes before, and only three behind, all of them armed with stout claws, and connected together by membranes; four grinding teeth above and below, the last of which [especially in the lower jaw] are the longest, all composed of numerous simple and parallel laminæ; the anterior of these laminæ forked towards the outer edge in the upper, and towards the inner one in the lower teeth. Only one species is known.

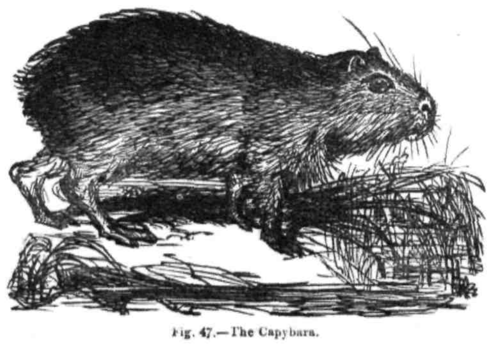

Fig. 47.—The Capybara.

The Capybara (*Cavia capybara*, Lin.), as large as a Siamese Pig, with very thick muzzle, short legs, coarse yellowish-brown hair, and no tail. Inhabits the rivers of Guiana and the Amazons, where it lives in troops: is a good swimmer, and the largest [existing] species of the *Rodentia*. The Beaver alone approaches it in size.

THE CAVIES, popularly termed *Guinea-pigs*, (*Anœma*, F. Cuv.; *Cavia*, Illig.),—

Are miniatures of the Capybara, except that their toes are separated, and their molars have each only a simple lamina, together with a forked one externally in those above, and on the inside in the lower.

The species best known is the common domestic Cavy, or *Guinea-pig* (*Cavia cobaia*, Pallas; *Mus porcellus*, *Lin.*), extremely common now in Europe, where it is bred in houses, under the [mistaken] supposition that its odour drives away Rats. It varies in colour like other domestic animals. [Six or seven species are now known, one of which, the Patagonian Cavy (*C. patachonica*, Pen.), is much larger than the rest, with remarkably long limbs: the author suspected it to be an Agouti. Some separate it by the appellation *Dolichotis*.]

THE MOCOS (*Kerodon*, F. Cuv.)—

Have grinders rather more simple than those of the Cavies, each being formed of two triangular prisms.

The only known species is also from Brazil, somewhat surpassing the Guinea-pig in size, and of an olive-grey colour.

* The Irish Hare has only recently been distinguished, and has hitherto been met with only in that island, where, until lately, the Common Hare was unknown. Great numbers of the latter, however, have been turned loose there during the last twelvemonth.

THE AGOUTIS (*Chloromys*, F. Cuv.; *Dasyprocta*, Ill.)—

Have four toes before and three behind, and four grinders above and below, of nearly equal size, with flat crowns irregularly furrowed, and a rounded contour, notched on the inner edge of those above, and the outer of those below. In disposition and the nature of their flesh, they resemble Hares and Rabbits, which they in some degree represent in the Antilles and hot parts of America.

[Several species have been ascertained, one with only two toes to the hind-feet. They employ their fore-feet to hold up food to the mouth.]

THE PACAS (*Cælogenys*, F. Cuv.; *Osteopera*, Harl.)—

With teeth pretty much resembling those of the Agoutis [and Porcupines], combine a very small additional toe on the inner side of the fore-foot, and two, equally small, on the sides of the hind-foot, which have consequently five in all. Besides this [and in addition to ordinary cheek-pouches], there is a cavity hollowed in each cheek, which dips under the projection of a very large and salient zygomatic arch, which imparts an extraordinary aspect to the skull. Their flesh is understood to be fine eating.

There is one species or variety of a fulvous colour, and another brown, both of which are spotted with white (*Cavia paca*, Lin.).

Finally, there remains an animal perhaps allied to *Cavia*, perhaps more approximating to *Lagomys*, or to the Rats, which we are unable to arrange for want of knowing its dentition,—the Chinchilla of the furriers, the skins of which are imported in immense numbers, but the body we have never been able to obtain. * * *

The Viscacha, described by Azzara, and such as we have seen it figured, can hardly be other than a large species of Chinchilla, with shorter and coarser fur.

[The progress of discovery has realized this expectation of the author, and we are now acquainted with three subdivisions of these animals, all of which have four rootless molars above and below, composed of alternating transverse layers of enamel and ivory: the form of the cranium and lower jaw indicates considerable affinity with the Cavies; but the clavicles are developed, and the aspect altogether more Rabbit-like, or rather approximating that of the Pikas; the eyes are placed far backward, the whiskers remarkably long and conspicuous, and the tail is always held recurved. These animals live socially in extensive burrows. The first subdivision is that of

THE VISCACHA (*Lagostomus*, Brookes),—

In which the fore-feet are furnished with four toes, the hinder with three only, as in the Cavies, all of them armed with stout claws adapted for digging. The ears are of moderate size, and the tail comparatively short. Their three anterior molars of the upper jaw consist each of two double layers, and the last of three; the lower of two each throughout.

The only known species (*L. trichodactylus*, Brookes,) is about the size of a Hare, and inhabits Chili and Brazil: its general colour is greyish, the fur of two sorts, one entirely white, and the other, which is coarser, black, except at the base; the under parts white. Its motions are quick, and resemble those of a Rabbit; and it seeks its food by night, subsisting wholly on vegetables: inhabits the level country, and is not esteemed as food. This animal is figured in Griffith's edition of the present work under the name of Diana Marmot.

The others are mountain animals, which frequent rocky places near the snow-line.

THE CHINCHAS (*Lagotis*, Ben.; *Legidium*, Meyer)—

Scarcely differ from the Viscacha except in having four toes to each foot, and a long bristly tail, as in the Chinchilla.

Two species are known; the first with long Rabbit-like ears, and greyish fur, from the Peruvian Andes (*L. Cuvieri*, Ben.; *Legid. peruvianum*, Mey.); the other from the Chilian Andes, with shorter ears, and fur inclining to reddish-brown (*L. pallipes*, Ben.).

Lastly,

THE CHINCHILLA (*Chinchilla*, Ben.; *Eriomys*, Vander Hoeven; *Callomys*, Gray),—

Has a fourth very small internal toe on the hind-foot: ears ample; the internal auditory bullæ remarkably capacious, appearing on the upper part of the skull. Each of the upper molars has three alternate layers of enamel and ivory, the inferior only two.

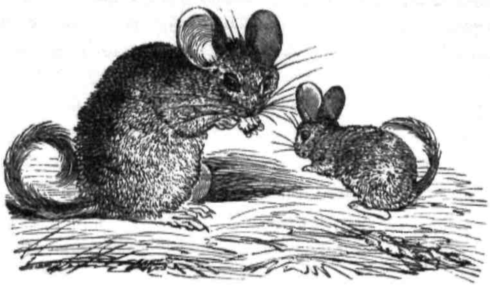

Fig. 48.—The Chinchilla.

One species only is well determined, the Chinchilla of the furriers (*Ch. lanigera*, Ben.), celebrated for the delicate fineness of its fur. It inhabits the Chilian and Peruvian Andes.

Somewhat allied to the foregoing, is another small group of South American rodents, with also four rootless molars of equal size above and below, except in one instance (*Abrocoma*), where the inferior resemble those of an *Arvicola;* they are surrounded with enamel, and doubled, or indented deeply, on both sides. The antorbital foramen is very large. There are five toes to each foot, except in *Abrocoma*, which has only four anteriorly; and the general aspect is intermediate to that of the Chinchillas and Rats or Voles: the head, however, is arched. Four subdivisions have been distinguished. In

THE ABROCOMES (*Abrocoma*, Waterh.),—

The ears are large, the claws very small, and the tail rather long and not tufted. The excessive fineness of their fur probably exceeds that of any other animal.

Two species were taken near Valparaiso by Mr. Darwin, *A. Cuvieri* and *A. Bennettii*, Waterh.

THE OCTODONS (*Octodon*, Bennett; *Dendrobius*, Meyer),—

Have also large ears, and a long and tufted tail: their inferior molars resemble those of the following.

The only known species (*O. Cummingii*, Ben.), is the *Sciurus degus* of Molina, *D. degus*, Meyer. It inhabits Chili, and is often seen traversing the branches of low underwood.

THE PŒPHAGOMES (*Poëphagomys*, F. Cuv.),—

Have narrow incisors, the auditory conch small, but distinct: claws adapted for burrowing.

The only ascertained species (*P. ater*) inhabits Chili.

Finally,

THE CTENOMYDS (*Ctenomys*, Ben.)—

Are distinguished by the great breadth of their incisors, by the smallness of their ears, their rather short tail, and stout claws, well qualified for burrowing.

There is a species in Brazil (*Ct. braziliensis*, Blainv.), and another near the Straits of Magellan (*Ct. Magellanicus*, Ben.)

A remarkable African rodent, which is in several respects allied to the last, is known as

THE CTENODACTYLE (*Ctenodactylus*, Gray),—

The incisors of which are rounded; there are but three molars, however, on each side of both jaws, surrounded with enamel, the upper with one deep indentation externally, the lower indented on both sides. The feet have each four toes, with the rudiment of a thumb on the anterior; and the hinder especially are furnished with stiff brush-like bristles, which curve over the toes (a structure which is also seen in the last preceding subdivisions). The general aspect resembles that of the Chinchilla group, to which the structure of the lower jaw bears also some resemblance; and there are similar great whiskers on the upper lip.

But one species is known (*C. Massonii*, Gray), from North Africa; size of a Rat, with a short tail, and pale yellowish-brown fur, of very fine texture.

The foregoing arrangement of the extensive series of *Rodentia* is by no means reduced to that simplicity which we conceive will ultimately be attained. Mr. Waterhouse, who has recently studied these animals very attentively, has succeeded in detecting several unexpected affinities which tend to this result: and he finds that the most useful or least variable characters, indicative of the mutual relations of the several genera, are derivable from the configuration of the cranium, and especially that of the lower jaw. The space allotted in this work forbids our entering into details; so that it must suffice to state that, in general, the members

of the first grand division are distinguished by having the inferior projecting angle of the lower jaw subquadrate, and not tapering to an acute point. In this group, or series, range first the *Sciuridæ*, or Squirrels and Marmots, followed by the Dormice, and next by the Jerboas, which latter require to be interpolated between the *Sciuridæ*, and the *Muridæ* or Rats; the Jerboas evincing several peculiar points of relationship with the Dormice: the *Arvicolidæ*, or Muskquash, Voles, and Lemmings, together with the Guaffres (*Geomys*), follow the *Muridæ*, and then succeed two isolated genera,—*Castor* and *Helamys*, which seem to constitute particular families: all these successive groups being readily distinguishable by the structure of the cranium and inferior jaw, combined with other characters. The members of the next great group have the inferior angle of the lower jaw acute, and usually four equal molars on each side above and below, having their folds of enamel gradually more complex. *Abrocoma, Octodon, Poëphagomys, Ctenomys, Capromys, Echymys, Myopotamus, Aulacodon,* then *Hystrix* and its allies, and near to the last *Cœlogenys* and *Dasyprocta*, form a very intelligible series, after which the bony palate contracts anteriorly, and we arrive at the *Cavidæ*, or Capybara, Moco, and Cavies, succeeded by the *Chinchillidæ*, and lastly by the Hares and Pikas, near which it may be that the Ctenodactyle holds its station. In the terminal genera, or the *Leporidæ*, the angle of the jaw suddenly ascends. It is probable that multitudes of existing rodents still remain to be discovered, a knowledge of some of which may assist in improving the general arrangement. But few have hitherto been met with in the ancient tertiary deposits, and those of genera still extant, as that of the Dormice in particular.]

THE SIXTH ORDER OF MAMMALIANS,—

EDENTATA,—

Or quadrupeds without teeth in the fore-part of their jaws, constitute our last principal division of unguiculated animals. Although brought together by a purely negative character, they have, nevertheless, some positive mutual relations, particularly in the great claws which encompass the ends of their toes, and which more or less approximate to the nature of hoofs; also by a certain slowness, or want of agility, obviously arising from the peculiar organization of their limbs. There are certain tolerably well-marked intervals, however, in these relations, which subdivide the order into three tribes.

THE TARDIGRADA

Compose the first of these divisions. They have a short face. The name refers to their excessive slowness, consequent upon a construction truly heteroclite, in which nature seems to have amused herself by producing something imperfect and grotesque. [A most strange assertion on the part of Cuvier, originating from a want of knowledge of the peculiar habits of these singular animals.] The only existing genus is that of

THE SLOTHS [as they are badly named] (*Bradypus*, Lin.),—

Which have cylindrical molars, and sharp canines longer than these molars; two pectoral mammæ; and the toes completely joined by the skin, and only marked externally by enormous compressed and crooked claws, which, when at rest, are always bent towards the palms, or soles, of the fore and hind feet. The latter are obliquely articulated on the leg, and apply only their outer edge; the phalanges of the toes are articulated by serrated ginglymi, and the first, at a certain age, becomes soldered to the metacarpal or metatarsal bones, which also, for want of use, become similarly anchylosed. To this inconvenience [?] in the organization of the extremities is added another, not less great, in their proportions. Their arms and fore-arms are very much longer than their thighs and legs, insomuch

that, when these animals advance [on the ground], they are obliged to drag themselves forward on their elbows. The pelvis is so large, and the thighs so much directed outwards, that they cannot approximate their knees. Their gait is the necessary consequence of so disproportioned [unusual] a structure.* These animals inhabit trees, and never remove from that on which they are located until they have stripped it of every leaf, so painful to them is the requisite exertion to reach another; it is even asserted that they let themselves fall from a branch to avoid the labour of descending. [The truth is, that these animals are modified for hanging by their limbs to the branches of trees, instead of supporting themselves upon the limbs like others: in this, their only natural posture, they are by no means slow in their movements; and they inhabit the densely intertangled forests of South America, where hundreds of miles may be traversed by passing from one tree to another: clinging by the hinder claws, the posterior limbs securely embracing the bough, and generally by one of their fore-limbs also, they employ the other to hook towards them the foliage on which they browze, whence the great length of their arms: and it is observed that in more open places, where the trees are less contiguous, the Sloths take advantage of windy weather to effect their transits, when the boughs are blown together and commingled. Their long and coarse shaggy hair protects them from insects: and in short, as is well remarked by Professor Buckland, the peculiar conformation of these animals ought no more to excite our pity and compassion, than the circumstance of fishes being deprived of legs. They are just as admirably adapted and fitly organized for their appointed singular mode of life as any other animal whatever.] The female produces but one young one at a birth, which she carries on her back.

The viscera of these animals are not less singular than the rest of their conformation. Their stomach [of enormous size] is divided into four compartments, somewhat analogous to the four stomachs of the ruminants, but without leaflets or other internal projecting parts; while the intestinal canal is short, and without a cœcum.

M. F. Cuvier applies the name *Acheus* to such of them as have three claws on their fore-feet; they have a very short tail.

Fig. 49.—The Ai, or Common Sloth

The Ai (*Br. tridactylus*, Lin.) is the species in which all the peculiarities of its genus are developed to the greatest extent. Its thumb and little toe, reduced to small rudiments, are concealed by the skin, and soldered to the metatarsus and metacarpus; the clavicle, also, reduced to a rudiment, is soldered to the acromion. Its arms are twice as long as its legs; the hair of its head, back, and limbs is long, coarse and unelastic, bearing some resemblance to dried grass, which gives it a forbidding aspect. The colour is greyish, often spotted with brown and white, [particularly when young]. Size that of a Cat. It is the only known mammalian which has nine cervical vertebræ [the fact being, that the eighth and ninth support rudimental ribs (as shown at Fig. 2, p. 39), and are therefore dorsal vertebræ, as in all the rest of the class: the more complete rotation of the neck, however, thus acquired by this extraordinary animal, having an obvious reference to its peculiar habits]. Some varieties of the Ai have been described as separate species, differing however in colour only: but the *Bradypus torquatus*, Geof., is very distinct, even in the bony structure of its head.

M. F. Cuvier reserves the name *Bradypus* for those species which have two claws only on their fore-feet (the *Cholæpus*, Illig.). Their canines are longer and more pointed, and they are quite destitute of tail. We know but of one,

The Unau (*Br. didactylus*, L.), which is rather less unfortunately (*malheureusement*) organized than the Ai. Its arms are shorter, its clavicles complete; there are fewer bones of its fore and hind feet which become soldered together. Its muzzle is more elongated, &c. It is larger by one half than the Ai, and of an uniform greyish-brown, which inclines sometimes to reddish.

These two animals are indigenous to the hot parts of America. Were it not for their stout claws, they would probably have been long since exterminated by the *Carnivora* of that country. [The lofty canopy from which they hang is beyond the reach of such enemies. In their affinities, the Sloths are closely related to the *Myrmecophagæ*.]

* Sir A. Carlisle has observed that the arteries of the limbs commence by subdividing into numerous ramifications, which afterwards re-unite into a single trunk, from which the usual branches proceed. This structure being also met with in the Loris, the gait of which is almost equally sluggish, it is possible that it may exert some influence on this slowness of motion. [It occurs also in the Whale, and the generality of birds, being connected rather with the power of protracting muscular exertion.] Independently of this, the Loris, the Ourang-outang, and the Coiata, all very slow animals, are remarkable for the length of their arms. [Still more so are the Gibbons, which are distinguished for the agility of their movements.]

There have been discovered in America the fossil skeletons of two animals belonging to the order *Edentata* [and lately another not yet named], of enormous dimensions: the first of them, the *Megatherium*, has a head very similar to that of a Sloth, but without canines, and approximating in the rest of its skeleton partly to the Sloths, and partly to the Ant-eaters, [most of all, however, to the minute *Chlamyphorus*, having even been covered by a similar massive buckler]. It is twelve feet long, and six or seven high. The other, the *Megalonyx*, is rather less: its toes are the only parts that are well known, and they strongly resemble those of the other.

The second tribe, comprehending

THE ORDINARY EDENTATA,—

Have the muzzle pointed. They have still molar teeth, and are divisible into two genera.

THE ARMADILLOS (*Dasypus*, Lin.)—

Are very remarkable among the *Mammalia*, for the scaly and hard [bony] shell, composed of pavement-like compartments, which covers their head and body, and often the tail. This substance forms a shield upon their forehead, another larger and more convex on the shoulders, a third on the crupper similar to the preceding, and between the two latter several parallel and moveable bands, which allow the body to bend. The tail is sometimes furnished with successive rings; and at others, with varied tubercles, like the legs. These animals have [generally] large ears, and also great claws, either five or four anteriorly, and always five to their hind-feet; a somewhat pointed muzzle; cylindrical grinding teeth separated from each other, to the number of seven or eight on each side of both jaws, and without enamel on the inside; a soft tongue, but little extensible; and there are a few scattered hairs between their scales, or on those parts of the body not covered by the shell. They excavate burrows, and subsist partly on vegetables, and partly on insects and carcases: their stomach is simple, and there is no cœcum. All of them are indigenous to the warm or at least temperate regions of South America.

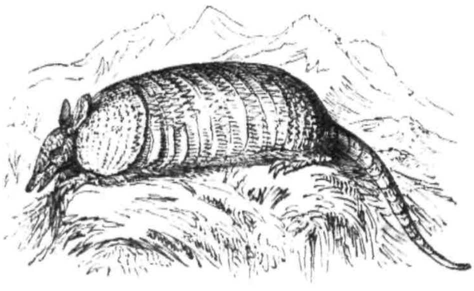

Fig. 50.—Peba Armadillo.

They may be arranged into subgenera, according to the structure of their fore-feet and the number of their teeth. The majority have only four toes anteriorly, of which the medial are the longest. Of this number are

THE CACHICAMES, F. CUV.,—

Which have only seven teeth on each side of both jaws; a pointed muzzle; and long tail encircled with bony rings. Such are

The Black Armadillo of Azzara (*D. novemcinctus*, Lin.), with nine intermediate bands, and sometimes but eight; also the Mule Armadillo of the same naturalist (*D. septemcinctus*), with a shorter tail than the preceding.

THE APARAS, F. CUV.,—

Have toes the same as in the Cachicames, but nine or ten teeth above and below.

The Apara Armadillo of Azzara (*D. tricinctus*, Lin.), with three intermediate bands, and a very short tail plated with regular tuberculated compartments. By enclosing its head and feet within its armour, this species is enabled to roll itself completely into a ball, like certain *Onisci*. It inhabits Brazil and Paraguay, and is one of those found farthest to the south.

Other Armadillos,

THE ENCOUBERTS, F. CUV.,—

Have five toes to their fore-feet, of which the three medial are the longest: their tail is in great part covered with quincunx scales, and their teeth are nine or ten in number, above and below. In this subdivision ranges

The Encoubert Armadillo, *Payou* of Azzara, (*D. sexcinctus* and *octodecemcinctus*, Lin.), which is distinguished from the rest of the genus by having a tooth on each side fixed in the intermaxillary bone: its coat of mail has six or seven bands, with smooth, large, and angular compartments; tail middle-sized, and annulated only at its base. The *Pichiy* of Azzara, and an allied species, the Hairy Armadillo (*Tatou velu*, Az.), resemble the Encoubert except in wanting the intermaxillary teeth, in having the posterior shell denticulated, and the parts that are not plated clad with longer and more close-set hairs.

A third principal division of these animals exhibits five toes to the fore-feet, but disposed obliquely, so that the thumb and index are slender, the latter being longest, the middle one bearing an enormous trenchant claw, the next having a shorter claw, and the fifth being shortest of any. This structure enables them to cut up the ground, and burrow very rapidly, or at any rate to hold on so firmly to the sides of their excavation as to be very difficult to detach. In this subdivision, or

THE CABASSOUS,—

There are eight or nine teeth on each side of both jaws.

The *Cabassou propre*, Buff.; *Tatouay*, d'Azz.; (*D. unicinctus*, Lin.)—Twelve intermediate bands; the tail long and tuberculated; the compartments of the bands and skin are square, and broader than long; five toes before, of which four are furnished with enormous claws, trenchant on their outer border. It attains a great size.

THE PRIODONTES, F. CUV.,—

With five anterior toes still more unequal, and claws even exceeding those of the Cabassous, possess twenty-two or twenty-four small teeth on each side above and below, making eighty-eight or ninety-six in all. Such is

The Giant Armadillo (*D. gigas*, Cuv.)—With twelve or thirteen intermediate bands, a long tail covered with imbricated scales, the compartments of which are square, and broader than long. It is the largest species of Armadillo, being sometimes three feet in length without the tail.

At the termination of the Armadillos, as a very distinct subgenus, [genus, or even family, to which the colossal *Megatherium* also appertains], may be placed

THE CHLAMYPHORES (*Chlamyphorus*, Har.),—

Which have ten teeth on each side of both jaws, five toes on each foot, the anterior claws very large, crooked, compressed, and furnishing (as in the Cabassous) a very powerful cutting instrument [adapted for digging]. The back is covered wlth a series of scaly pieces, arranged transversely, without any solid buckler either before or behind, but forming a sort of cuirass, which is only connected with the body along the spine. The hind part of the body is abruptly truncated, and the tail incurved and partially attached to the under part of the body: [it is covered with small scales, and expanded at the tip. The osteology of this animal, as given by Mr. Yarrell (*Zool. Journ.*, No. xii.), is considerably allied to that of the Cabassous. There is a singular tuberosity on the skull over each eyebrow.

We know but of one (*Chlamyphorus truncatus*, Harlan), only five or six inches in length; it is a native of the interior of Chili, where it passes most of its time under ground, [and is either very rare (perhaps verging towards extinction), or difficult to obtain on account of its subterraneous habits].

N.B. There have been found, in America, some fossil bones of a gigantic Armadillo, which appears to have been about ten feet long exclusive of the tail. (See my *Ossemens Fossiles*, vol. v. part 1, p. 191, note.)

THE ORYCTEROPES (*Orycteropus*, Geof.)—

Have been long confounded with the Ant-eaters, inasmuch as they subsist on the same food, have a similar-formed head, and a tongue which is somewhat extensible; but they are distinguished by having grinding teeth, and flat claws, adapted for burrowing rather than for cutting open ant-hills. The structure of their teeth is different from that of all other quadrupeds; they are solid cylinders, traversed, like reeds, in a longitudinal direction, by an infinitude of little canals. The stomach is simple, and muscular towards its outlet, and the cœcum small and obtuse.

Only one species is known of this genus, the Cape Orycterope (*Myrmecophaga capensis*, Pallas), which the Dutch colonists style the *Ground Hog*. It is an animal about the size of a Badger or larger, low upon the legs, with scanty greyish-brown hair, and tail shorter than the body and as little clad. It inhabits burrows, which it forms with extreme rapidity; and its flesh is eaten.

The remaining *Edentata* possess no grinders whatever, and consequently have no teeth at all. There are two genera.

THE ANT-EATERS (*Myrmecophaga*, Lin.)—

Are well covered with hair, have a long muzzle which terminates by a small toothless mouth, from which is protruded a filiform tongue, susceptible of considerable elongation, and which they insinuate into ant-hills and the nests of the *Termites*, whence these insects are withdrawn by being entangled in the viscid saliva that covers it. Their fore-nails, strong and trenchant, which vary in number according to the species, enable them to tear open the nests of the *Termites*, and also furnish them with effective means of defence. When at rest, these nails are always half-bent inwards, resembling a callosity of the tarsus; hence these animals can only bring the side of the foot to the ground. Their stomach is simple, and muscular towards its outlet, their intestinal canal moderate, and without a cœcum.*

The members of this genus are peculiar to the warm and temperate regions of South America, and produce but one young at a birth, which is carried on the back.

Fig. 51.—Great Ant-eater.

The Maned or Great Ant-eater (*M. jubata*, Auct.), upwards of four feet in length, with four anterior claws and five hind ones, and a tail furnished with long hairs vertically directed, both above and beneath. Its colour is greyish-brown, with an oblique black band bordered with white on each shoulder. It is the largest species of Ant-eater; and stated [but erroneously] to defend itself from the Jaguar. It inhabits low places, never ascends trees, and moves slowly.

The Tamandua (*M. tamandua*, Cuv.; *Myrm. tetradactyla* and *M. tridactyla*, Lin.).—Figure and feet of the preceding, but not half the size; the tail scantily furnished with hair, and naked and prehensile at the tip, enabling the animal to suspend itself to the branches of trees. Some of them are of a yellowish-grey, with an oblique band on the shoulder, that is only visible at a certain light; others are fulvous with a black band; some fulvous, with the band, crupper, and belly black; and others again black altogether. It is not yet known whether these differences indicate species.

The Two-toed Ant-eater (*Myrm. didactyla*, Lin.).—Size of a Rat, with fulvous woolly hair, and a russet line along the back, the tail prehensile and naked at the tip, and only two claws anteriorly, one of them very large, and four to the hind-foot. [Were it not for the interposition of the preceding species, it is doubtful whether the author would have arranged this curious little animal in the same minimum group as *M. jubata*: it has been separated by some naturalists; and its close affinity with the Sloths is very obvious.]

THE PANGOLINS (*Manis*, Lin.),—

Are also without teeth, have an extensile tongue, and subsist on Ants and Termites in the manner of the Tamanduas; but their body, limbs, and tail, are covered with large trenchant imbricated scales, which they elevate in rolling themselves into a ball, when they wish to defend themselves against an enemy. All their feet have five toes. Their stomach is slightly divided in the middle part of it, and they have no cœcum. *They occur only in the ancient Continent.*

[Four or five species are now ascertained, inhabiting Asia and Africa, and varying from three to five feet in length]. The Short-tailed Pangolin (*M. pentadactyla*, Lin.), is the *Phattagen* of Ælian. An unguinal phalanx has been found, in the Palatinate, of a Pangolin that must have been twenty feet long, or more. (See Cuv., *Oss. foss.* vol. v. part 1, p. 193.)

The third tribe of *Edentata* comprehends animals which M. Geoffroy designates

MONOTREMATA,

On account of their having but one external opening for all their excretions. Their generative organs present extraordinary anomalies: though without a ventral pouch, they have nevertheless the same supernumerary bones to the pubis as the *Marsupiata*; the *vasa deferentia* terminate in the urethra, which opens into the cloaca; the penis, when retracted, is drawn into a sheath, which opens by an orifice near the termination of the cloaca. The only matrix consists of two canals or trunks, each of which opens separately and by a double orifice into the urethra, which is very large, and terminates in the cloaca. As yet naturalists are not agreed as to the existence of their mammæ†; nor whether these animals are viviparous

* Daubenton has described two small appendages in the *M. didactyla*, which, in strictness, may be considered as cœca. I have satisfied myself, however, that they do not exist in *M. tamandua*.

† M. Meckel considers as such two glandular masses which he found greatly developed in a female *Ornithorynchus*. These M. Geoffroy deems to be rather glands, analogous to those on the flanks of the

or oviparous.* The singularities of their skeleton are not less remarkable; there being a sort of clavicle common to both shoulders, placed before the ordinary clavicle, and analogous to the *furcula* of birds. Lastly, in addition to five claws on each foot, the males have a peculiar spur on the hind ones, perforated by a canal which transmits a liquid secreted by a gland situated on the inner surface of the thigh: it is asserted that the wounds it inflicts are venomous.† These animals have no external conch to the ear, and their eyes are very small.

The Monotremes are found only in New Holland, where they have been discovered since the settlement of the English. There are two genera known.

THE ECHIDNAS (*Echidna*, Cuv.; *Tachyglossus*, Illig.: sometimes called *Spiny Ant-eaters*).

The elongated slender muzzle of these animals, terminated by a small mouth, and containing an extensile tongue, resembles that of the Ant-eaters and Pangolins, and like them, they feed on Ants. They have no teeth, but their palate is provided with several ranges of small spines, directed backwards. Their short feet have each five long and very stout claws, fitted for burrowing; and all the upper part of their body is covered with spines, as in a Hedgehog, [but much larger and more powerful]. It appears that in the moment of danger, they have also the faculty of rolling themselves into a ball. The tail is very short; stomach ample and nearly globular, and the cœcum of middle size.

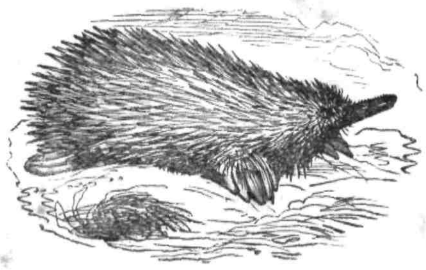

Fig. 52.—Echidna

Two species have been discovered,—the Spiny Echidna (*E. hystrix*), completely covered with large spines,—and the Bristly Echidna (*E. setosa*), covered with hair, among which the spines are half-hidden. Some consider the difference as only arising from age.

THE DUCKBILLS (*Ornithorynchus*, Blumenbach; *Platypus*, Shaw).

Muzzle elongated, and at the same time singularly enlarged and flattened, presenting the greatest external resemblance to the bill of a Duck, and the more so as its edges are similarly furnished with small transverse laminæ. They have no teeth except at the bottom of the mouth, where there are two on each side of both jaws, without roots, with flat crowns, and composed, as in the Orycterope, of small vertical tubes. Their fore-feet have a membrane which not only connects the toes, but extends beyond the claws: in the hinder, the membrane reaches only to the base of the claws; two characters which, in addition to their flattened tail, indicate aquatic habits. Their tongue is to a certain extent double; one in the bill beset with villosities; and another at the base of the first, thicker, and furnished anteriorly with two little fleshy points. The stomach is small, oblong, and has its outlet near the entrance; cœcum small; and there are numerous salient and parallel laminæ in the course of the intestines. The penis has only two tubercles. These animals inhabit the rivers and marshes of New Holland, and particularly the neighbourhood of Port Jackson.

Fig. 53.—The Ornithorynchus.

Two species only are known, one with smooth and thin reddish fur (*O. paradoxus*, Blum.); the other with blackish-brown fur, flat, and somewhat frizzled. These are perhaps only varieties of age.

Shrews. [*Prof. Owen has since demonstrated them to be mammary,* although these animals (like the true *Cetacea*) have no teats or nipples, *the lacteal secretion transuding by a number of minute pores.*]

* Travellers have lately asserted, that they have been ascertained *to produce eggs. Should this prove to be the case, the Monotremes* must, in some sort, be considered as a particular class of animals; but *it is much to be wished, that some competent anatomist would minutely* describe these eggs, their internal origin, and their developement after exclusion. [*Prof. Owen has since conclusively shown that the Monotremata are not oviparous, but must resemble in their reproduction the Marsupiata.* The young have never yet been met with *attached to the mammæ of their dam, but from the structure of the* beak in very young *Ornithorhynci*, which have been found in the *burrows, there can be little doubt that the mouth forms, at first,* a suctorial disk, adapted to hold on an even flat surface.]

† *There is reason to suspect that this statement is without foundation*, as the animals never attempt to employ the spur as a weapon of defence.—ED.

THE SEVENTH ORDER OF MAMMALIANS.

PACHYDERMATA.

The *Edentata* terminate the series of unguiculated *Mammalia*, and we have just seen that there are some of them with claws so large, and so enveloping the ends of the toes, as to approximate to the nature of hoofs. Nevertheless, they have still the faculty of bending these toes round various objects, and of seizing with more or less force. The entire absence of this faculty characterizes the *hoofed* animals. Using their feet only as supports, they in no instance possess clavicles. Their fore-arms remain constantly in the state of pronation, whence they are reduced to feed on vegetables. Their forms and mode of life present therefore much less variety than in the *unguiculated* animals, and they can hardly be divided into more than two orders,—those which ruminate, and those which do not; but the latter, which we bring together under the general term *Pachydermata*, admits of some subdivision into families.

The first is that of the Pachyderms, which have a proboscis and tusks, or the

PROBOSCIDEA,*—

Which are distinguished by having five toes to each foot, very complete in the skeleton, but so enveloped by the callous skin which surrounds the foot, that their only external appearance consists in the nails attached to the extremity of this species of hoof. They have no canines, nor incisors properly speaking; but in the incisive [or intermaxillary] bones are implanted two defensive tusks, which project from the mouth, and frequently attain enormous dimensions. The magnitude of the sockets necessary to hold these tusks renders the upper jaw so high, and so shortens the bones of the nose, that the nostrils in the skeleton are placed near the top of the face: but in the living animal they are prolonged into a cylindrical trunk, composed of several thousands of small muscles variously interlaced, flexible in all directions, endowed with exquisite sensibility, and terminated by an appendage like a finger. This trunk imparts to the Elephant as much address as the perfection of the hand does to the Monkey. It enables him to seize whatever he wishes to convey to his mouth, and sucks up the water he is to drink, which, by the flexure of this admirable organ, is then poured into the throat, thus supplying the want of a long neck, which could not have supported so large a head with its heavy tusks. Within the parietes of the cranium, however, are several great cavities, which render the head lighter: the lower jaw [except in a fossil genus when immature,] has no incisors whatever; the intestines are very voluminous; the stomach simple; cœcum enormous; the mammæ, two in number, placed under the chest. The young suck with the mouth and not with the trunk. Only one living genus exists, that of

THE ELEPHANTS (*Elephas*, Lin.),—

Which comprehends the largest of terrestrial Mammalia. The astonishing services performed by their trunk, an instrument at once supple and vigorous, an organ both of touch and smell, contrast forcibly with the clumsy aspect and massive proportions of these animals; and being conjoined to a very imposing physiognomy, have contributed to exaggerate their intellect. After studying them for a long time, we have not found it to surpass that of the Dog, or of several other *Carnaria*. Naturally of a mild disposition, Elephants live in troops conducted by the old males. They subsist wholly on vegetables.

Their distinctive character consists in the grinders, the bodies of which are composed of a certain number of vertical laminæ, each formed of a bony substance, enveloped with enamel, and cemented

* The Proboscideans have various affinities with certain Rodents; 1stly in the magnitude of their incisors [tusks]; 2ndly, in their grinders being often formed of parallel laminæ; 3rdly, in the form of several of their bones, &c.

together by a third substance, termed the *cortical;* in a word, similar to those we have already seen in the Cavies, and some other Rodents. These grinders succeed each other not vertically, as our permanent teeth replace the milk teeth, but from behind forwards, so that as fast as one tooth becomes worn, it is pushed forward by that which comes after it; hence it happens that the Elephant has sometimes one, sometimes two grinders on each side, or four or eight in all, according to its age. The first of these teeth is always composed of fewer laminæ than those which succeed them. It is stated that certain Elephants thus change their molars eight times: their tusks, however, are changed but once.

The Elephants of the present day, covered with a rough skin nearly destitute of hair, inhabit only the torrid zone of the ancient Continent, where hitherto but two species have been discovered.

The Asiatic Elephant (*E. indicus,* Cuv.).—Head oblong, with a concave forehead; the crown of the grinders presenting transverse undulating ridges (*rubans*), which are sections of the laminæ which compose them, worn down by trituration. This species has smaller ears than the next one, and has four nails to the hind foot. It is found from the Indus to the Eastern Ocean, and in the large islands to the south of India. From time immemorial this species has been employed as a beast of draught and burden; but has never yet propagated in captivity, though the assertion respecting its modesty and repugnance to copulate before witnesses is utterly devoid of foundation. The females have very short tusks, and in this respect many of the males resemble them.

The African Elephant (*E. africanus,* Cuv.).—Head round, with a convex forehead; very large ears; and grinders presenting lozenge-shaped eminences on their crowns. It appears to have often only three toes on the hind-foot. This species inhabits from Senegal to the Cape of Good Hope. Whether they ascend the eastern coast of Africa, or are replaced there by the Asiatic species, is not yet ascertained. The tusks of the female are as large as those of the male, and the weapon itself is generally larger than in the preceding. This animal is not now tamed in Africa, though it appears that the Carthaginians employed it in the same way that the inhabitants of India do theirs.

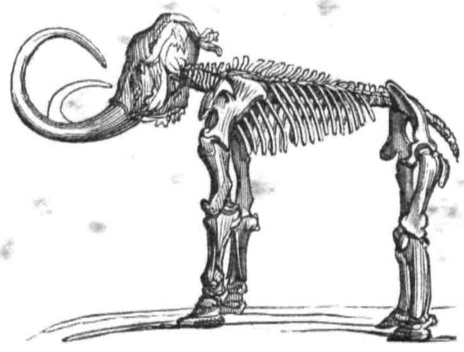

Fig. 54.—Mammoth Skeleton.

In nearly every part of the two Continents, are found, under ground, the bones of a species of Elephant allied to that of India, but the grinders of which bear straighter and narrower eminences, the sockets for the reception of the tusks are much longer, and the lower jaw is more obtuse. A specimen recently taken from the ice on the coast of Siberia, by Mr. Adams, appears to have been densely covered with hair of two kinds, so that it is possible that this species may have lived in cold climates. It [is termed the Mammoth Elephant (*E. primogenius,* Cuv.), and] has long been quite extinct.

The second genus of Proboscideans, or that of

THE MASTODONS (*Mastodon,* Cuv.),—

Has been quite destroyed, no species of it being now alive. They had the feet, tusks, trunk, and many other details of conformation the same as the Elephants; but their grinding teeth differed in having large conical tubercles above the gum, which, by detrition, were reduced to disks of various size, that represent sections of the tubercles, (a conformation common to the Mastodon, Hippopotamus, Pig, &c., which has induced the erroneous idea that the first were carnivorous). These grinders, which succeeded each other from behind as in the Elephants, present also so many pairs of points, as the animal was advanced in age. [There are small tusks in the lower jaw of the immature Mastodon, in which state it is the *Tetracaulodon* of Godman.]

The Great Mastodon (*M. giganteum,* Cuv.), in which the tubercles were lozenge-shaped, is the species most celebrated. It equalled the Elephant in size, but with still heavier proportions. Its remains are found in a wonderful state of preservation, and in great abundance through all parts of North America*: in the Eastern Continent they are of much rarer occurrence.

Narrow-toothed Mastodon (*M. angustidens*).—Much narrower grinders than the preceding, the tubercles of which, when worn down, present trefoil-shaped discs, whence they have been mistaken by some authors for the grinders of the Hippopotamus. This species was one-third less than the Great Mastodon, and much lower on the legs. [Two or three have been confounded under its name.] Its teeth, in certain places, tinged with iron, become of a fine blue when heated, forming what is called the "oriental turquoise."

* An almost perfect skeleton, made up however of the bones of different individuals, found in the celebrated deposit of "Big-bone lick," is mounted in the Museum of Philadelphia.—ED

Our second family is that of the

PACHYDERMATA ORDINARIA,—

Which have four, three, or two toes to their feet. Those in which the toes make even numbers have feet somewhat cleft, and approximate the Ruminants in various parts of the skeleton, and even in the complication of the stomach. They are usually divided into two genera.

THE HIPPOPOTAMI (*Hippopotamus*, Lin.)—

Have four nearly equal toes to each foot, terminated by little hoofs; six grinders on each side of both jaws, the three anterior of which are conical, the posterior presenting two pairs of points, which, by detrition, assume a trefoil shape; four incisors above and below, those of the upper jaw short, conical, and recurved, the inferior prolonged, cylindrical, pointed, and horizontally projecting; a canine tooth on each side above and below, the upper straight, the lower very large and recurved, those of the two jaws rubbing against each other.

These animals have a very massive body, naked of hair; very short legs, their belly almost touching the ground; an enormous head, terminated by a swoln muzzle, which encloses the apparatus of their large front teeth; a short tail, and small eyes and ears. Their stomach is divided into several sacs. They live in rivers, upon roots and other vegetable substances, and display much ferocity and stupidity.

One living species only is known, the *H. amphibius*, Lin., now confined to the rivers of medial and south Africa. It formerly found its way to Egypt by the Nile, but has long disappeared from that country.

The European freshwater deposits contain the bones of a species of Hippopotamus very similar to that of Africa, and also of two or three others successively smaller. (See my *Researches on Fossil Bones*, vol. i.)

THE PIGS (*Sus*, Lin.)—

Have two large middle toes to each foot, armed with strong hoofs, and two much shorter lateral ones that hardly touch the ground. Their incisors vary in number, but the inferior always slant forward; the canines project from the mouth and curve upward: muzzle terminated by a truncated snout adapted to turn up the soil, and stomach but slightly divided.

THE PIGS, properly so called,—

Have from twenty-four to twenty-eight grinders, the posterior of which are oblong, with tuberculated crowns, the anterior more or less compressed, and six incisors to each jaw.

The Wild Boar (*Sus scropha*, Lin.), which is the parent stock of our Domestic Hog and its varieties, has prismatic tusks that curve outward and slightly upward; the body stout and thick; straight ears; the hair bristly and black: the young ones are variegated black and white. It does great injury to fields in the neighbourhood of forests, by tearing up the ground in search of roots.

The Domestic Pig varies in size and length of limbs, in the direction of its ears, and also in colour; being white or black, sometimes red, and often varied. Every one is acquainted with the usefulness of this animal, on account of the flavour of its flesh, and the length of time it can be preserved by means of salt; the facility with which it is fed; and its great fecundity, which surpasses that of all other animals of its size, the female often producing fourteen young at a litter. The period of gestation is four months, and they produce twice a year. The Hog continues to increase in size for five or six years, is prolific at one, and sometimes lives to twenty. Although naturally savage, they are social, both wild and tame, and know how to defend themselves against Wolves, by forming a circle, and presenting a front in every direction. Voracious and savage, they do not even spare their own young, [at least, if the parent be disturbed soon after their birth]. This species is spread throughout the globe, and none but Jews and Mahometans refuse to eat its flesh. [It appears to be indigenous only, however, to Europe and Asia, extending to the Peninsula of Hindostan: the Chinese breed is probably a distinct species, though it commingles freely with the other.]

The Masked Boar (*S. larvatus*, F. Cuv.; *S. africanus*, Schreber; *Sanglier de Madagascar*, Daub.)—Tusks like the Common Hog; but on each side of the muzzle, near the tusks, is a large tubercle, somewhat like the nipple of a woman, supported by a bony prominence, which imparts a singular physiognomy to the animal. It inhabits Madagascar and the south of Africa.

The Babyroussa (*Sus babyrussa*, Buff. Supp.)—Longer and more slender legs than the others, with slender tusks turned vertically upwards, those of the upper jaw inclining spirally backward. It inhabits several islands of the Indian Archipelago. [The Papuan Hog (*S. papuensis*) is another distinct species from New Guinea.]

From the Pigs require to be separated

THE WART-HOGS (*Phascochœres*, F. Cuv.),—

The grinders of which are composed of cylinders, cemented together by a cortical substance, almost like the transverse laminæ of the Elephant, and like them succeeding each other from behind. Their skull is singularly large, the tusks rounded, directed laterally upward, and of a frightful magnitude; and on each of their cheeks hangs a thick fleshy lobe, which completes the hideousness of their aspect. They have but two incisors above and six below.

The individuals received from Cape Verd (*S. africanus*, Gm.) have generally the incisive teeth complete; those which arrive from the Cape of Good Hope (*S. æthiopicus*, Gm.) scarcely show any trace of them, although vestiges are sometimes found within the gum. This difference may perhaps arise from age, which has worn down the teeth of the latter, or it may indicate a specific diversity, the more especially as the heads of those from the Cape are rather larger and shorter.

There is still better reason to separate from the genus of Pigs—

THE PECCARIES (*Dycoteles*, Cuv.),—

Which have certainly grinders and incisors very like those of the Pigs properly so called, but their canines, directed as in the generality of the class, do not project from the mouth, besides which they want the external toe to their hind-feet. They have no tail, and upon the loins is a glandular opening from which a fetid humour exudes. The metacarpal and metatarsal bones of their two great toes are soldered into a kind of cannon-bone, as in the Ruminants; with which their stomach, also, divided into several sacs, presents a marked analogy. It is a singular fact, that the aorta of these animals is often found very much enlarged, but not always in the same part, as if they were subject to a kind of aneurism.

There are two species known, both inhabitants of South America, which were first distinguished by Azzara. Linnæus confounded them together under the name of *Sus tajassu*.

The Collared Peccary (*D. torquatus*, Cuv.).—Hair annulated grey and brown; a whitish collar, stretching obliquely from the angle of the lower jaw over the shoulder. Size half that of the Wild Boar.

The White-lipped Peccary (*D. labiatus*, Cuv.).—Larger; and brown, with white lips.

Here may be placed a genus now unknown among existing animals, which we have discovered, and named

ANOPLOTHERIUM, Cuv.,—

And which presents the most singular relations with the different tribes of ***Pachydermata***, approximating, in some respects, to the order *Ruminantia*. Six incisors to each jaw, four canines almost similar to the incisors and of even length with them, and seven molars on each side above and below, form a continuous series without any intervening space, a disposition of the teeth seen elsewhere in Man only. The four posterior molars on each side resemble those of the Rhinoceroses, the Damans, and Palæotheriums; that is to say, they are square above, and form double or triple crescents below. The feet, terminated by two great toes, as in the Ruminants, are yet different in the circumstance of the metacarpal and metatarsal bones remaining always separated, or being never united into a cannon-bone. The construction of their tarsus is the same as in the Camel.

The bones of this genus have hitherto only been found in the gypsum quarries near Paris. We have already recognized five species: one the size of a small Ass, with the low form and long tail of an Otter (*A. commune*, Cuv.), the fore-feet of which have a small internal accessory toe; another of the size and slender form of the Gazelle (*A. medium*); a third no bigger and with nearly the same proportions as a Hare, with two accessory toes to the sides of its hind-feet, &c. (See my *Ossemens fossiles*, tom. iii.)

The ordinary Pachydermata which have not cloven feet comprehend, in the first place, three genera, the molar teeth of which are very similar, there being seven on each side with square crowns, and various prominent lines, and seven in the lower jaw, the crowns of which form double crescents, and the last of all a triple one: their incisors, however, vary.

THE RHINOCEROSES (*Rhinoceros*, Lin.)—

In this respect differ from one another. They are large animals, with each foot divided into three toes, and the nasal bones of which, very thick and united into a kind of arch, support a solid horn, which adheres to the skin, and is composed of a fibrous and horny substance, resembling agglutinated hairs.

They are naturally stupid and ferocious; frequent marshy places; subsist on herbage and the branches of trees; have a simple stomach, very long intestines, and great cœcum.

The Indian Rhinoceros (*Rh. indicus*, Cuv.).—In addition to its twenty-eight grinders, this species has two stout incisive teeth in each jaw, together with two other intermediate smaller ones below, and two still more diminutive outside of its upper incisors. It has only one horn, and its skin is remarkable for the deep folds into which it is thrown behind and across the shoulders, and before and across the thighs. It inhabits the East Indies, and chiefly beyond the Ganges.

The Javanese Rhinoceros (*Rh. javanus*, Cuv.),—with the great incisors and single horn of the preceding, has fewer folds in the skin, though one of them on the neck is larger; and, what is remarkable, the entire skin is covered with square angular tubercles, [as is also the case, to a partial extent, in the preceding; from which it further differs in having a comparatively slender head].

The Sumatran Rhinoceros (*Rh. sumatrensis*, Cuv.),—with the same four great incisors as the foregoing, has no folds to the skin, which is besides hairy, and there is a second horn behind the first.

The African Rhinoceros (*Rh. africanus*, Cuv.) [or rather Rhinoceroses, three species of them being now ascertained].—Two horns as in the preceding; and no folds of the skin, nor any incisor teeth, the molars occupying nearly the whole length of the jaw. This deficiency of incisors might warrant a separation from the others. [The Great Rhinoceros (*Rh. simus*, Burchell), which considerably exceeds in size any of the others, is further distinguished by its pale colour, its very long and straight anterior horn, and remarkably short hind one, and particularly by the form of its upper lip, which is not capable of elongation, and a certain degree of prehension, as in all the others: it is the most gregarious of any, and also the most inoffensive, frequenting the open karoos. The common Cape Rhinoceros (*Rh. africanus* or *capensis*) is darker, with also unequal horns, the posterior being shorter; and the Ketloa Rhinoceros (*Rh. ketloa*), recently discovered by Dr. Smith, is an animal of solitary habits, with horns of equal length, reputed to exceed the rest in ferocity.*]

There have been found, under ground, in Siberia and different parts of Germany, the bones of a double-horned Rhinoceros, the skull of which, besides being much more elongated than in any known existing species, is further distinguished by a bony vertical partition that supported the bones of the nose. It is an extinct animal; but of which a carcase, almost entire, exposed by the thawing of the ice on the banks of the Vilhoui in Siberia, showed to have been covered with tolerably thick hair. It is possible, therefore, that it inhabited northern climates, like the fossil Elephant.

More recently there have been disinterred, in Tuscany and Lombardy, other Rhinoceros bones, which appear to have belonged to a species allied to the African. Some have been found, in Germany, with incisors like the Asiatic species; and lastly, there have been discovered, in France, the bones of one which announce a size scarcely larger than a Pig. [It appears that several of the fossil species were destitute of the nasal horn.]

THE DAMANS (*Hyrax*, Hermann)—

Were long placed among the *Rodentia*, on account of their very small size; but, on examining them carefully, it will be found that, excepting the horn, they are little else than Rhinoceroses in miniature; at least they have quite similar molars; but the upper jaw has two stout incisors curved downwards, and, during youth, two very small canines; the inferior four incisors, without any canines. They have four toes to each of their fore-feet, and three to the hind-feet, all, excepting the innermost posterior, which is armed with a crooked and oblique nail, terminated by a kind of very small, thin, and rounded hoof. The muzzle and ears are short: they are covered with hair, and have only a tubercle in place of a tail. The stomach is divided into two sacs; their cœcum is very large, and the colon has several dilatations, and is also furnished with two appendages about the middle, analogous to the two cœca of birds.

Only one species is known, the size of a Rabbit, and greyish: it is not uncommon in rocky places throughout Africa, where it is much preyed on by rapacious birds, and it also appears to inhabit some parts of Asia; at least we cannot perceive any certain difference between the *Hyrax capensis* and *H. syriacus*. [Five, if not six, are now conclusively established; one of which, indigenous to South Africa, even ascends trees.]

THE PALÆOTHERIUM, Cuv.—

Is another lost genus: with the same grinders as the two preceding, six incisors and two canines to each jaw as in the Tapirs, and three visible toes to each foot, it combined a short fleshy trunk, for the muscles of which the bones of the nose were shortened, leaving a deep notch underneath. We have discovered the bones of this genus, mingled with those of the Anoplotherium, in the gypsum quarries in the environs of Paris, and they occur in several other parts of France; [also, with those of the *Chœropotamus*, *Dichobune*, &c., other lost genera of *Pachydermata*, in the Binstead quarries of the Isle of Wight, England].

* Previous to discovering this species, a fine specimen of which is deposited in the British Museum, Dr. Smith received information, from the natives, of the existence of five sorts of these animals in South Africa, which are distinguished there by separate names one of them is stated to have only a single horn.—ED.

Eleven or twelve species are already known. At Paris alone, we nave found one the size of a Horse, another that of a Tapir, and a third of a small Sheep: the bones of a species nearly equalling the Rhinoceros in size have been met with in the neighbourhood of Orleans. These animals appear to have frequented the borders of lakes and marshes, for the deposits which enclose their remains contain also those of freshwater shells. (See my *Ossemens fossiles*, tom. iii.)

THE LOPHIODONS—

Form another extinct genus, which appears to have been closely allied to the preceding one; but the inferior incisors of which exhibit transverse ridges. Ten or twelve species have been exhumed from the same ancient freshwater deposits that have yielded the Palæotheriums.

To these last genera succeeds that of

THE TAPIRS (*Tapir*, Lin.),—

Wherein the twenty-seven molars, before they are worn, present transverse and rectilinear ridges; there are six incisors and two canines in each jaw, separated from the molars by a wide interval. The nose assumes the form of a short fleshy trunk; and the fore-feet have each four toes, the hinder but three.

For a long while only one species was known, that of America (*T. americanus*, Lin.), which is the size of a small Ass, with a brown and almost naked skin, a short tail, and fleshy neck, that forms a crest at the nape. It is common in humid places and along the rivers of the warm parts of America, where its flesh is eaten. The young are spotted with white like the fawns of a Stag. Within a few years, a second species has been discovered in the Eastern Continent (*T. indicus*), of larger size than the other, and brown-black, with the back greyish white. It inhabits the forests of the Malay peninsula, the island of Sumatra, &c. Still more recently, Dr. Roulin has discovered in the Cordilleras a third species, of a black colour, and covered with thick hair; the bones of its nose are more elongated, a particular in which it somewhat approximates the Palæotheriums.

There have also been found in Europe some fossil bones of Tapirs, and, among the rest, those of a gigantic species approaching the Elephant in size (*T. giganteus*, Cuv., *Oss. foss.*) "The lower jaw of this huge animal has been obtained by M. Schleyermacher, and proves to possess enormous canines, which must have projected from the mouth, [and are directed downwards]: it should therefore form a separate genus. Its size may have been greater than that of the Elephant by one half. [A more perfect head of this extraordinary species, the largest of the *Pachydermata* hitherto discovered, has been lately disentombed in Germany, and described by Prof. Kaup. With two other species, successively smaller, it now composes the genus *Deinotherium*, the members of which are suspected by Blainville and other anatomists to have been aquatic animals, destitute of posterior extremities, like the Dugongs and Manati.]

The third family of *Pachydermata*, or of hoofed animals that do not ruminate, consists of the

SOLIDUNGULA,

Or quadrupeds with only one apparent toe and a single hoof to each foot, although beneath the skin, on each side of their metacarpus and metatarsus, there are appendices (*stylets*) which represent two lateral toes. But one genus of them is known, that of

THE HORSES (*Equus*, Lin.).

There are six incisors to each jaw, which, during youth, have their crowns furrowed with a groove, and six molars on each side above and below, with square crowns, marked by laminæ of enamel which penetrate them, with four crescents, besides which there is a small disk on the inner border of those above. The males have in addition two small canines in their upper jaw, and sometimes in both, which are always wanting in the females. Between these canines and the first molar, there is a wide space which corresponds with the angle of the lips, where the bit is placed, by which alone Man has been enabled to subdue these powerful quadrupeds. Their stomach is simple and middle-sized; but their intestines are very long, and cœcum enormous. The teats are situate between the thighs.

The Horse (*E. caballus*, Lin.).—This noble associate of Man in the chase, in war, and in the labours of agriculture, arts and commerce, is the most important and carefully tended of domestic animals. It does not appear to exist in the wild state, excepting in those countries where the offspring of tame individuals have been suffered to run wild, as in Tartary and America, where they live in troops, each conducted and defended by an old male. The young males, expelled as soon as they have attained the age of puberty, follow the troop at a distance, until they have attracted some of the younger mares.

In a state of servitude, the colt continues sucking for six or seven months, and the sexes are separated at two years; at three they are first handled and accustomed to some management, and at four saddled and mounted, at which age they can propagate without injuring themselves. The period of gestation is eleven months.

A Horse's age is known by his incisors. The middle teeth begin to appear about fifteen days after birth; and at two years and a half the middle ones are replaced; at three and a half the two next follow; and at four and a half, the outermost or *corner* teeth. All these teeth, with originally-indented crowns, lose by degrees this character by detrition. At seven and a half or eight years, the depressions are completely effaced, and the Horse is no longer marked.

The inferior canines appear at three years and a half, the superior at four years; they remain pointed until the sixth, and at ten begin to peel away.

The life of a Horse seldom extends beyond thirty years. Every one knows how much this animal varies in size and colour. The principal races even exhibit sensible differences in the form of the head, and in their proportions, each being specially adapted for some particular mode of employment.

The most beautiful and swift are the Arabs, which have contributed to perfect the Spanish breed, and with the latter to form the English: the stoutest and strongest are from the coasts of the North Sea; and the most diminutive from the north of Sweden and Corsica. Wild Horses have a large head, frizzled hair, and ungraceful proportions. [If the figure of Pallas be correct, of the Wild Horse of northern Asia, it is doubtful, from the length of the ears and some other characters, whether a distinct species intermediate to the true Horse and the following be not represented. M. Serres suspects that a species of *Equus* now extinct is represented on the celebrated mosaic of Palestrina. Bones of this genus are not uncommon in the older tertiary strata, and have even been found in those of South America.

The Dzegguetai (*Equus hemionus*, Pallas).—A distinct species, intermediate in its proportions to the Horse and Ass, which lives in troops in the sandy deserts of Central Asia. Colour isabelle, with black mane and [broad] dorsal line; a terminal black tuft to the tail. This was probably the Wild Mule of the ancients.

The Ass (*E. asinus*, Lin.).—Known by its long ears, the tuft at the end of its tail, and the black line crossing the dorsal one over its shoulders, which is the first indication of the transverse stripes that occur in the following species. [Some of the young have obscure cross-bands on the legs.] Originally from the vast deserts of the interior of Asia, the Ass is still found there free and unreclaimed, in numerous troops, which migrate north and south according to the season: hence it does not thrive in countries too much to the north. Its patience, sobriety, hardy constitution, and the services which it renders to the poor, are well known to every one. The harshness of its voice, or *bray*, is occasioned by two small peculiar cavities situate at the bottom of the larynx.

The Zebra (*E. zebra*, Lin.).—Nearly the form of the Ass, and everywhere transversely striped with black and white in a regular manner. It is indigenous to the whole south of Africa. We have known a female Zebra produce successively with the Horse and the Ass.

The Couagga (*E. quaccha*, Gm.), resembles the Horse more than the Zebra, but inhabits the same country as the latter. Its coat is brown on the neck and shoulders, transversely striped with whitish; the crupper reddish-grey, and tail and legs whitish. Its name expresses the sound of its voice, which is not unlike the bark of a Dog.

The Onagga or Dauw (*E. montanus*, Burchell).—Another African species, inferior [?] in size to the Ass, but with the handsome form of the Couagga, and of an isabelle colour, striped with alternately broader and more narrow black markings on the head, neck, and body. The hinder stripes are disposed obliquely forward, and the legs and tail are white.

THE EIGHTH ORDER OF MAMMALIANS,—

RUMINANTIA,—

Is, perhaps, the most natural and the best determined of the whole class, for all the species which compose it appear to have been constructed on the same model, and the Camels alone present some inconsiderable exceptions to the general characters of the group.

The first of these characters is that of having no incisors in the upper jaw, while the inferior has always eight, [the two outermost of which represent canines, as can be easily shown]. They are replaced above by a callous pad. Between the incisors and the molars is a wide space, where, in some genera, there are one or two canines.* The molars, almost always six in number above and below, have their crowns marked with two double crescents, the convexity of which is turned inwards in the upper, and outwards in the lower jaw.

The four feet are each terminated by two toes, and by two hoofs, which present a flat surface to each other, appearing as though a single hoof had been cleft: hence the names that have been applied to these animals, of cloven-footed, bifurcated, &c.

Behind the hoof there are always two small spurs, which are vestiges of lateral toes. The

* Though acquainted with all the subdivisions of *Ruminantia*, we have never seen more than one canine in any animal whatever; and in the Camels, wherein the inferior canine has been recognized as such, there are never more than *six* lower incisors.—ED.

two bones of the metacarpus and metatarsus are united into a single one, designated the *cannon* bone; but in certain species there are also vestiges of lateral metacarpal and metatarsal bones.

The name *Ruminantia* intimates the singular faculty possessed by these animals, of masticating their food a second time, it being returned to the mouth after the first deglutition. This faculty depends on the structure of their stomachs, which are always four in number, the first three of which are so disposed that the food may enter into either of them, the œsophagus terminating at the point of communication.

The first and largest stomach is named the *paunch;* it receives a large quantity of vegetable matters coarsely bruised by the first mastication. From this it passes into the second, termed the *honey-comb bag,* the parietes of which are laminated like the cells of Bees. This second stomach, very small and globular, seizes the food, and moistens and compresses it into little pellets (or *cuds*), which afterwards successively return to the mouth to be rechewed. The animal remains at rest during this operation, which lasts until all the herbage first taken into the paunch has been subjected to it. The aliment thus remasticated descends directly into the third stomach, termed the *feuillet,* on account of its parietes being longitudinally laminated somewhat like the leaves of a book, from which it descends into the fourth or *caillette,* the coats of which are wrinkled, and which is the true organ of digestion, analogous to the simple stomach of animals in general. In the young of the ruminants, while they continue to subsist on the milk of the mother, the *caillette* is the largest of the four. The paunch is only developed by receiving great quantities of herbage, which finally give it its enormous volume. These animals have the intestinal canal very long; but there are few enlargements in the great intestines. The cœcum is likewise long and tolerably smooth. Their fat hardens more by cooling than that of other quadrupeds, and even becomes brittle. It is commonly termed *tallow.* The udder is placed between the thighs.

The Ruminants, of all animals, are those which are most useful to Man. They furnish him with food, and nearly all the flesh that he consumes. Some serve him as beasts of burden, others with their milk, their tallow, leather, horns, and other products.

The two first genera are without horns.

THE CAMELS (*Camelus*, Lin.),—

Approximate the preceding order rather more than the others. They have not only always canines in both jaws, but have also two pointed teeth implanted in the intermaxillary bones, six inferior incisors, and from eighteen to twenty molars only; peculiarities which, of all the *Ruminantia,* they alone possess, besides which the scaphoid and cuboid bones of the tarsus are separated. Instead of the great hoof, flat at its inner side, which envelopes the whole inferior portion of each toe, and which determines the figure of the ordinary cloven foot, they have but one small one, which only adheres to the last phalanx, and is symmetrically formed like the hoofs of the *Pachydermata.* Their tumid and cleft lip, their long neck, projecting orbits, weakness of the crupper, and the disagreeable proportions of their legs and feet, render them in some sort deformed; but their extreme sobriety, and the faculty they possess of passing several days without drinking, cause them to be of the highest utility.

It is probable that this last faculty results from the great masses of cells which cover the sides of their paunch, in which water is constantly retained or produced. The other Ruminants have nothing of the kind.

Camels urinate backward, but the direction of the penis changes during copulation, which is effected with considerable difficulty, and while the female lies down. In the rutting season a fetid humour issues from the head.

THE CAMELS, properly so called,—

Have the two toes united below, almost to the point, by a common sole, and humps of fat upon the back. They are large animals of the Eastern Continent, of which two species are known, both of them completely domesticated.*

* Pallas states, on the authority of the Bucharians and Tartars, that there are wild Camels in the deserts of Central Asia; but we may remark that the Calmucks are in the habit of liberating all sorts of animals from a religious principle.

The Bactrian or Two-humped Camel (*C. bactrianus*, Lin.),—originally from Central Asia, and which descends much less to the south than

The Arabian or One-humped Camel (*C. dromedarius*, Lin.), which is spread from Arabia into all the north of Africa, and great part of Syria, Persia, &c.

The first is the only one employed in Turkostan, Thibet, &c.; and is sometimes led as far as Lake Baikal. The second is well known, in consequence of the necessity of employing it in crossing the great Desert, being the only means of communication between the countries on its borders.

The Two-humped Camel walks less painfully than the other on humid ground; and is also larger and stronger. Previous to renewing its coat it sheds the whole of its hair. It is the One-humped Camel that is the most abstemious. The *Dromedary* is merely a lighter variety of it, better fitted for expedition.

The flesh and milk of the Camel serve for food, and its hair for garments, to the people who possess it. In rocky or stony countries both species are useless. [Buffon considered the humps and callous pads on the legs of these animals as marks of servitude: on the contrary, they are admirable instances of direct adaptation to their indigenous locality. The enlargement and convex soles of their feet are expressly fitted for treading on loose yielding sand; and their humps are provisions of superabundant nutriment, which are gradually absorbed and disappear on the occasion of a scarcity of other food, as is particularly observed at the end of a long journey. By resting on their callosities, they are enabled to lie down and repose on a scorching surface; and finally, the abundant supply of fluid in their stomach is too obvious a provision, in reference to their peculiar requirements, to need even this passing allusion.]

THE LAMAS (*Auchenia*, Illiger),—

Have their two toes separate, and are without humps. Only two clearly distinct species are known, both from the New World, and much smaller than the preceding.

The Lama, which, in its wild state, is termed *Guanaco* (*Camelus llacma*, Lin.).—As large as a Stag, with dense hair of a chestnut-colour, but varying when the animal is domesticated. It was the only beast of burden which the Peruvians possessed at the time of the conquest. It can carry a hundred and fifty pounds, but can only make short journeys. The *Alpaca* is a variety with long woolly hair.

The Vicugna (*Cam. vicunna*, Lin.).—Size of a Sheep, and covered with fulvous wool, of admirably fine texture, and of which valuable stuffs are manufactured. [The Lamas are mountain animals, peculiar to the Andes. M. Alc. d'Orbigny, who has long resided in their native country, distinguishes four species of them, viz., the Lama and Alpaca, which have been completely reduced to servitude, and the Guanaco and Vicugna, which constantly refuse to copulate with the others.

The bones of an animal related to the Lamas, but which must have equalled the Camels of the eastern hemisphere in stature, and which had three toes to the fore-feet, have lately been recovered by Mr. Darwin in Paraguay: the *Macrauchenia*, Owen].

THE MUSKS (*Moschus*, Lin.),—

Are very much less anomalous than the Camels, differing only from ordinary Ruminants in the absence of horns, by a long canine on each side of the upper jaw, which projects beyond the mouth in the males, and lastly, by having a slender peronæum, which is not present even in the Camel. They are remarkable for their elegance and lightness.

The Pouched Musk (*M. moschiferus*, Lin.), is the most celebrated species. Size that of a Roe, and almost without tail; it is completely covered with hairs, so coarse and brittle that they might almost be termed spines: what particularly distinguishes it, however, is the pouch situate before the prepuce of the male, which contains an odorous substance, well known in medicine and perfumery by the appellation *musk*. This species appears confined to that rugged and rocky region from which most of the Asiatic rivers descend, and which extends between Siberia, China, and Thibet. Its habits are nocturnal and solitary, and timidity extreme. It is in Thibet and Tonquin that it yields the best musk; that of the north being almost inodorous. [The difference more probably arises from the amount of adulteration, which is practised to a vast extent.]

The other Musks have no musk-pouch, [and constitute the *Tragulus* of Bennett]. They inhabit the warm parts of the eastern hemisphere, and are the smallest and most elegant of the *Ruminantia*. Such are *M. pygmæus*, Buff.; *M. memina*, Schreb.; and *M. javanicus*, Buff.

All the other Ruminants, at least of the male sex, have two *horns;* that is to say, two prominences of the frontal bones, more or less long, which occur in no other group of animals.

In some, these prominences are covered with an elastic sheath, formed as it were of agglutinated hair, which continues to increase by layers during life. The name of *horn* is applied to the substance of this sheath, and the sheath itself is termed the *core*. The prominence which it envelopes grows with it during life, and never falls. Such are the horns of *cattle*, as Oxen, Sheep, Goats, and Antelopes.

In others, the prominences are only covered with a hairy skin, continuous with that of the head: these prominences do not fall; and the Giraffes afford the only example.

Finally, in the genus of Stags, the prominences, covered for a while with a hairy skin like the other parts of the head, have at their base a ring of bony tubercles, which, as they enlarge, compress and obliterate the nutritive vessels of that skin, [commonly termed the velvet]. It becomes dry, and is thrown off: the bony prominences, being laid bare, at the expiration of a certain period separate from the skull to which they were attached; they fall, and the animal remains defenceless. Others, however, are reproduced, generally larger than before, which are destined to undergo the same fate. These horns, purely osseous, and subject to periodical changes, are styled *antlers*.

THE STAGS (*Cervus*, Lin.)—

Are consequently ruminants which have heads armed with antlers; but, if we except the Rein Deer, the females in no instance possess them, [save in rare individual cases *]. The substance of these antlers, when completely developed, is that of a dense bone without pores or internal cavity: their figure varies greatly according to the species, and even in each species at different ages. These animals are extremely fleet; live mostly in forests; and feed on grass, the leaves and buds of trees, &c.

Those species which have antlers either wholly or partially flattened may be first distinguished; such as—

The Elk, or Moose Deer (*C. alces*, Lin.).—As large as a Horse, and sometimes larger; very high upon the legs; with a swoln cartilaginous muzzle, and a sort of goitre, or variously shaped pendulous swelling, under the throat; hair always very stiff, and of an ash-colour, more or less dark. The antlers of the male, at first dagger-shaped, and then divided into narrow slips, assume, at the age of five years, the form of a triangular blade, dentelated on its outer edge, and borne on a pedicle. They increase with age, so as to weigh fifty or sixty pounds, and to have fourteen branches on each horn. The Elk lives in troops in the marshy forests of the north of both continents, and its skin forms valuable leather.

The Rein Deer (*C. tarandus*, Lin.).—Size of a Stag, but with shorter and stouter limbs; both sexes have antlers, divided into several branches, at first slender and pointed, and finally terminating with age in broad dentelated palms: the hair, brown in summer, becomes almost white in winter. It is peculiar to the glacial regions of both continents, and is the animal so celebrated for the services which it renders to the Laplanders, who have numerous herds of them, which in summer they lead to the mountains, and in winter bring back to the plains: it is their only beast of burden and draught, its milk and flesh serve them for food, its hide for clothes, &c.

Fig. 55.—Red Deer.

The Fallow Deer (*C. dama*).—Less than the Stag, and blackish-brown in winter, fulvous spotted with white, in summer; the buttocks always white, bordered on each side with black: tail longer than that of the Stag, black above and white below. The horn of the male is round at base, with a pointed antler, and throughout the rest of its length flattened, with its outer edge dentelated. After a certain age it shrinks, and splits irregularly into several slips. This species, the *Platyceros* of the ancients, has become common throughout Europe, but appears to have been originally from Barbary. A blackish variety without spots [even in the fawns] is not uncommon.

The species with round antlers are more numerous. Those of temperate climates change colour, more or less, with the seasons.

The Common Stag, or Red Deer (*C. elephas*, Lin.).—Fulvous-brown, with a black dorsal line, and on each side of it a series of small pale fulvous spots, in summer; uniform greyish-brown in winter: the crupper and tail pale fulvous at all seasons. It is indigenous to the forests of all Europe, and of the temperate parts of Asia. The antlers of the male are round, and appear in the second year, at first dagger-shaped, and then with branches on their inner side, which increase in number with age; they are crowned finally with a sort of palmation, having

* There is the head of a female Roe, with antlers, in the Museum of the Royal College of Surgeons, London. The connexion of these defences, however, with the sexual organs is remarkable. They do not grow in emasculated individuals; and the rutting season immediately follows their developement. In *Lin. Trans.* vol. ii. p. 356, an instance is recorded of a Doe with only a single horn, resembling that of a three-year-old Buck; and on dissection, the ovary of the same side was found to be schirrous. After attaining their maximum of developement, the antlers of these animals decrease, in old age, at each successive renewal.—ED.

many points. When very old, the Stag becomes blackish, and the hairs on the neck lengthen and become erect. The antlers are shed in spring, the old ones losing them first; and are reproduced in summer, during the whole of which period the males associate separately. When they are grown again, the rutting season commences, which lasts three weeks, at which time the males become furious. Both sexes unite in vast herds to pass the winter. The hind carries eight months, and brings forth in May; the fawn is fulvous, spotted with white.

The Canadian Stag, or *Wapiti; Elk* of the Anglo-Americans (*C. canadensis*, Gm.; *C. strongyloceros*, Schreb.)—A fourth larger than our Stag, and nearly of the same colour, but with the disk of the crupper larger and paler, the horns equally round, but more developed, and without a palm. Inhabits all the temperate parts of North America.

The Virginian Stag, or *Deer* of the Anglo-Americans (*C. virginianus*, Gm.).—Less than ours, and more elegantly formed; the muzzle more pointed; of a pale fulvous in summer, reddish-grey in winter; the under part of the throat and tail white at all seasons. Antlers shorter than in the European species, and very differently formed.

Fig. 56.—Cervus macrourus.

The species inhabiting warm climates do not change colour. There are several in South America, at present but imperfectly determined; as *C. paludosus*, Desm.; *C. campestris*, F. Cuv.; *C. nemoralis*, H. Smith, &c. There are also several in the East Indies; as the Axis (*C. axis*, Lin.), permanently spotted with pure white, and which is indigenous to Bengal, but propagates easily in Europe: also *C. Aristotelis*, Cuv., which, with long hairs on the neck and throat, and inhabiting the north of India, must correspond with the *Hippelaphus* of Aristotle, &c., &c. Several of these have canine teeth.

The Roe (*C. capreolus*, Lin.),—with but two tines to its antlers: of a greyish-fulvous; the buttocks white; no infra-orbital sinuses, and scarcely any tail. Some individuals are very bright russet, and others blackish. This species lives in pairs in the elevated forests of temperate Europe, sheds its antlers at the close of autumn, renews them in winter, undergoes the rut in November, and remains with young five months and a half. Its flesh is much more esteemed than that of the Stag. There are none in Russia. The Tartarian Roe (*C. pygargus*, Pallas) is larger, with longer hair, and horns more spinous at their base. It inhabits the high grounds beyond the Volga. There are also some Roes in America, the antlers of which always remain simple, or without tines; as *C. rufus*, F. Cuv., with canines in both jaws, *C. nemorivagus*, F. Cuv., and *C. simplicicornis*, H. Smith.

In India there are some small species which might be separated from the other Roes, having sharp canines, and short antlers borne upon pedicles, covered with hair on the forehead: such are the Muntjac, or Kijang, (*C. muntjac*, Gm.), which is found in small herds at Ceylon and Java, the *C. philippinus*, H. Smith, *C. moschatus*, Id., &c.

THE GIRAFFE (*Cameleopardalis*, Lin.)—

Is characterized by conical horns in both sexes, that are always covered with a hairy skin, and never fall. The bony nucleus of them is articulated during youth to the frontal bone by a suture. In the middle of the forehead, there is an eminence or third horn, broader and much shorter, but equally articulated by suture. This animal is in other respects one of the most remarkable that exist, on account of the great length of its neck and the disproportionate extension of its fore-legs.*

Only one species is known (*C. giraffa*, Lin.), confined to the deserts of Africa, which has short hair, marked with angular fulvous spots on a greyish ground, and a slight mane on the hind-neck. It is the tallest of all animals, its head being frequently raised eighteen feet from the ground. Its disposition is gentle, and it feeds on leaves.

THE RUMINANTS WITH HOLLOW HORNS—

Are more numerous than the others, and we have been necessitated to divide them into genera upon characters of trivial import, derived from the form of the horns, and the proportions of the various parts. To these M. Geoffroy has advantageously added those afforded by the substance of the frontal prominence, or the bony nucleus of the horn.

* The Giraffe is essentially a modified Deer, with persistent horns. Of three dissected, however, by Prof. Owen, one proved to possess a large gall bladder, like the Antelopes; whereas no trace of this receptacle existed in either of the others, as in the Deer tribe.—ED.

and the head, but not the neck, devoid of feathers. They are birds of moderate size, and in strength do not approach the Vultures properly so called; hence they are even more addicted to carrion and all sorts of filth, which attract them from afar. They do not even disdain to feed on excrement.

The White Neophron (*V. percnopterus*, Lin.)—Little larger than a Raven: the adult male [and probably also the old female] white, with black quill-feathers; the female and young brown. [It is common in Africa, and the countries bordering the Mediterranean; rare in the north of Europe: has been once killed in England.] It follows the caravans in the desert, to devour all that dies.

The Urubu (*V. jota*, Ch. Bonap.), or *Carrion Crow* of the Anglo-Americans.—The same size and form as the preceding, but with a stouter bill, and the head entirely naked; plumage wholly deep black. It abounds in the temperate and hot parts of America, [and is generally ranged in *Cathartes*. One or more additional true Neophrons, however, exist in Africa.]

THE GRIFFINS (*Gypäetos*, Storr),—

Placed by Gmelin in his genus *Falco*, approximate the Vultures rather in their habits and conformation: they have the eyes even with the head; the claws proportionally feeble; wings half-extended when at rest; the craw, when full, projecting at the bottom of the neck: but their head is completely covered with feathers; [and they have only thirteen cervical vertebræ, which is one more than in any of the Falcons; the Neophrons and Gallinazos possessing fourteen, and the Condors and true Vultures fifteen. The sternum is proportionally short, and very broad.] Their distinctive characters consist in a very strong, straight beak, hooked at the point, and inflated on the curve; nostrils covered [owl-like] with stiff hairs directed forward; and a pencil of similar hairs under the beak: their tarsi are short, and feathered to the toes; and their wings long, having the third quill longest.

The Bearded Griffin, or *Lammer-geyer*, (*V barbatus*, and *Falco barbatus*, Gm.).—This is the largest bird of prey belonging to the Eastern Continent: it inhabits the high chains of mountains, but is not very common. It nestles in inaccessible acclivities; attacks Lambs, Goats, the Chamois, and even, it is said, sleeping Man [or persons standing on the edge of a precipice]; it is pretended that children have been sometimes carried away by it, [a statement recently confirmed by facts, in more than one instance]. Its method is to force animals over steep precipices, and to devour them when disabled by the fall. It does not, however, refuse dead bodies. Its length is nearly five feet (French), and extent of wing from nine to ten feet. This bird is the *Phene* of the Greeks, and the *Ossifraga* of the Latins. [The species of the Himmalayas is considered to be different.]

THE FALCONS (*Falco*, Lin.)—

Constitute the second, and by much the most numerous division of the diurnal birds of prey. They have the head and neck covered with feathers: their eye-brows [except in the Ospreys] form a projection which occasions the eye to appear sunk, and imparts a very different character to their physiognomy from that of the Vultures: the majority of them subsist on living prey; but they differ much in the amount of courage displayed in the pursuit of it. Their first plumage is often differently coloured from the adult, and they do not [in most instances] assume the latter for three or four years,—a circumstance which has occasioned the species to have been greatly multiplied by nomenclators. The female is generally one-third larger than the male, which, on this account, has been named a *tercel*.

It is necessary to subdivide this genus first into two sections.

THE FALCONS, properly so called, (*Falco*, Bechstein), commonly termed the *Noble Birds of Prey*,—

Compose the first. They are the most courageous in proportion to their size, a quality which is derived from the power of their armature and wings. Their beak (fig. 74), curved from its base, has a sharp tooth on each side near the point; and the second quill of their wings is the longest, the first nearly equalling it, which renders the entire wing longer and more pointed. From this, also, result particular habits: the length of the quills of their wings weakens their efforts to ascend vertically, and renders their forward flight, in a calm state of the atmosphere, very oblique, necessitating them, when they wish to rise directly, to fly against the wind. They are

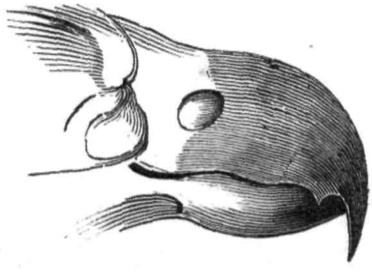

Fig. 74.—Beak of Jer Falcon.

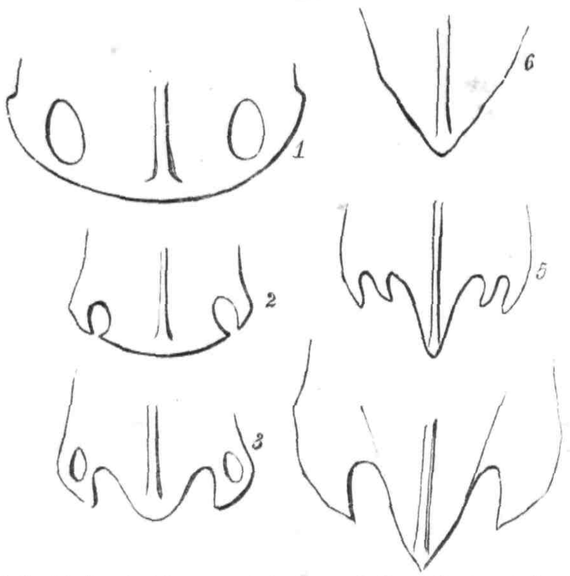

Fig. 73.—1, hind margin of the sternum of a true Vulture—2, ditto, of Neophron—3, ditto, of *Cathartes aura*—4, ditto, of *C. Californianus*, the foramina of which have become obliterated —5, ditto, of another presumed *Cathartes*—6, ditto, of Secretary.

The Fulvous Vulture (*V. fulvus*, Gm.) is the most widely-diffused species, inhabiting the mountainous parts of the whole ancient continent. Its body surpasses in size that of a Swan [possibly in the instance of some females. This bird has been erroneously stated to have fourteen tail-feathers.* The greater number of the genus possess similar characters.]

The Dusky Vulture (*V. cinereus*, Gm.)—As widely distributed as the preceding [but less numerously], and still larger: it frequently attacks living animals. [This species exemplifies the subgenus *Gyps* of Savigny: having the beak more sharply pointed, the nostrils almost round, and the head partially clothed with feathers. The Vultures generally, indeed, have the head and neck feathered when young, like the Turkey and other birds which have bald heads in a state of maturity: the immature *V. Angolensis*, Gm., is doubtfully figured by Bennett as a species of Caracara (*Polyborus? hypoleucos*); but the adults of that species continue to have those parts invested.]

The Oricou Vulture (*V. auricularis*, Daud.), an African species, [probably the largest of the true Vultures,] has a longitudinal fleshy crest on each side of the neck, above the ear, [a character which likewise occurs, less prominently, in one or two others].

America produces Vultures remarkable for the caruncles which surmount the membrane at the base of the beak; the latter is as large as in the preceding, but the nostrils are oval and longitudinal. They are

THE CONDORS (*Sarcoramphus*, Dumeril),—

[A very distinct genus, remarkable for having no muscles attached to the trachea, in consequence of which they are necessarily deprived of voice, emitting no sound beyond a weak snorting. Their hind toe is shorter than in other *Accipitres.*]

The King Condor (*V. papa*, Lin).—Size of a Goose. The naked parts of the head and neck vividly coloured, and the caruncle denticulated like the comb of a cock. It inhabits the Pampas and other hot parts of South America. This species is termed *the King of the Vultures*, from the Gallinazos giving place to it, through fear, whenever it settles upon a carcase which they had begun to devour.

The Great Condor (*V. gryphus*, Lin.); the male of which, in addition to his superior caruncle†, has another under the beak, like the cock. The female differs in colour, and is without the caruncles. This bird has been rendered famous by exaggerated reports of its size: it is little larger than the Bearded Griffin, which its manners resemble. It inhabits the most elevated regions of the Andes, and flies higher than any other bird.

THE GALLINAZOS (*Cathartes*, Cuv.)—

Have the beak of the Condors, that is to say, large, with longitudinal oval nostrils, but no fleshy crest: their head and neck are without feathers; [plumage nearly or wholly black: the sternum emarginated inward of the ordinary foramen. All the species are from America.]

The Great Gallinazo (*V. californianus*, Shaw),—approaches the large Condor in size, with proportionally longer wings. [From the western coast of North America.]

The *Turkey Buzzard* of the Anglo-Americans (*V. aura*, Lin.)—Little larger than a fowl. [There appear to be others, hitherto imperfectly determined.]

THE NEOPHRONS (*Neophron*, Cuv.)—

Have a long and slender beak, rather tumid above its curvature; the nostrils oval and longitudinal,

* No species of bird has more than twelve tail-feathers (including the *uropygials*) till we arrive at the Poultry. Hence, the *Alectura*,—mentioned in the preceding note,—which possesses eighteen, might on this character alone have been referred to its proper station.

† It is proper to remark that the rigid cartilaginous crest of the male of this Condor offers no analogy, anatomically, with the flaccid caruncle of the other.—ED.

THE ANTELOPES (*Antilope*, Lin.)—

Have the substance of the bony nucleus of the horn solid, with neither pores nor cavity, like the antlers of the Stags. They also further resemble the Stags in possessing infra-orbital sinuses, in the slenderness of their form, and speed of foot. They compose a very numerous genus [consisting now of more than seventy well-ascertained species], which we have been compelled to subdivide principally after the shape of the horns.

a. Horns annulated, with a double curvature; the points forward, or inward and upward, [in other words, annulated and lyrated; also placed forward on the head, above the eye: the muzzle and around the nostrils hairy. This is the most characteristic section of the genus, and the species composing it may be distinguished by the term *Gazelles*.]

The Numidian Gazelle (*A. dorcas*, Lin.).—Round, thick, and black horns, with the size and graceful shape of the Roe: pale fulvous above, white below; a brown band along each flank, a tuft of hair on each knee, and a deep pouch on each groin. Inhabits the north of Africa in innumerable herds, which form a circle when attacked, presenting horns on every side. Is the ordinary prey of the Lion and the Panther. The soft expression of its eye supplies the Arabic poets with many images.

[To this division belong also the *A. euchore, Kevella,** *Bennettii, arabica, corinna, Soëmmeringii, mhorr, dama, ruficollis, melampus*, and *pygargus*, which last seems to tend through *A. caama, bubalus*, &c., to the Gnus. The author likewise includes *A. gutturosa*, Pallas, the *Hoang-yang* or *Yellow Goat* of the Chinese, herds of which inhabit the arid plains of Central Asia, and the *A. saiga*, Pal., or *Colus* of Strabo, a European animal, indigenous to the south of Poland and Russia]; it is as large as a Fallow Deer, and fulvous in summer, whitish-grey in winter. Its cartilaginous, thick, and vaulted muzzle, with very expanded nostrils, obliges it to retrograde in feeding. The herd sometimes consists of more than ten thousand individuals. [We are inclined to approximate to the Saiga a remarkable species from Northern India, the Chiru (*A. Hodgsoni*, Abel); it is somewhat less than the Fallow Deer, of a whitish colour, with the face and front of the limbs black; horns nearly straight, or but slightly lyrated, and remarkably long and slender, rising abruptly from the forehead. Among the true Gazelles, may be particularly noticed the Springer, or *Spring-bok* (*A. euchore*) of the Cape colonists, so celebrated for occasionally visiting, during seasons of drought, the cultivated lands of South Africa in innumerable herds, which devastate wherever they pass.] It is larger than the Numidian Gazelle (*A. dorcas*), and nearly of the same form and colour; is distinguished by a fold of skin on the crupper, clothed with long white hairs, which opens and enlarges at every bound the animal takes. [The *A. Soëmmeringii* is still larger, and of a delicate pale buff-yellow or *nankeen* colour, the hairs singularly disposed in zig-zag patches, imparting a peculiar waved appearance.]

Fig. 57.—Spring-bok.

b. Horns annulated, and with a triple [spiral] curve.

The Indian Antelope (*A. cervicapra*, Lin.).—Still very like the Gazelles, but the horns have a triple flexure. [Colour variable, black or different shades of brown, relieved with white around the eyes, and below: this animal is remarkable for the great developement of its infra-orbital cavities].

The Addax, or Nubian Antelope (*A. addax*, Licht.).—Also three curves to the horns, which are larger and more slender than those of the preceding: it is whitish, tinged with grey on the back, and has a large brown spot on the forehead. [There are horns in both sexes, as in most of the foregoing: this animal seems to be allied rather to *A. strepsiceros*, pertaining to a subsequent section.]

c. Horns annulated, with a double curve, but winding in an opposite direction to those of the preceding, the points directed backward; the *Damalis* of H. Smith, in part.

The Bubalus of the ancients (*A. bubalus*, Lin.).—More heavily formed than the others; the head [very] long [and the eyes situate remarkably backward]: size of a Stag, and yellowish-brown, except the end of the tail, which is terminated by a black tuft. A common species in Barbary. The *A. caama*, or *Harte-beeste* of the Cape colonists, [and *A. lunata*,] range in this division. [These animals have much the aspect of a small Cow, and inhabit the more sterile regions of Africa in small herds, headed by an old male. They are easily domesticated.]

Fig. 58.—Addax.

* The *A. subgutturosa*, Gm., remarks the author, has not been pretended to differ from *A. Kevella*, further than in having a slight swelling under the throat.

d. Small, straight, or but slightly curved horns, shorter than the head; peculiar, in most of the species, to the male sex, [and placed far backward, behind the eyes: these animals have a distinct maxillary gland, and naked muzzle: there is generally a tuft of long hair between the horns. The crupper is broad and elevated, the body heavy, and general form approximating that of the small Musks (*Tragulus*), the Hog Deer, and, we may add, the Agoutis: they are denominated *Bush Antelopes* (*Philantomba*, Ogilby), from their natural haunts.

Fig. 59.—Great Bush Antelope.

At their head may be placed the Great Bush Antelope (*A. silvicultrix*), much larger than the rest, and dark-coloured, with a white stripe along the back, becoming very broad on the crupper. In its train follow,—*A. mergens, pygmæa, Maxwellii, perspicilla, Natalensis, philantomba, Burchellii, grimmea*, and one or two others; some of them very diminutive: the delicate little *A. saltiana* appears to rank on the extreme confines. The author likewise admits a very peculiar species, the *Klip-springer* (*A. oreotragus*), distinguished by its stiff brittle hair, of a greenish-yellow colour, and especially by the singular structure of its hoofs, which do not expand or project forwards, their outline being perpendicular with the leg: its name signifies *rock-springer*. He also places here the Woolly Antelope (*A. lanata*, Desm.).]

Fig. 60.—Steen-bok (*A. tragulus*).

e. Annulated horns with a simple curve, the point directed forward (*Redunca*, Smith). [The muzzle still naked.

To this group belong the *A. redunca, scoparia, quadriscopa, montana, tragulus, capreolus, eleotragus, isabellina, Lalandii, pedeotragus, rufescens, madagua, melanotis*, &c.]

f. Horns annulated, straight, or a little curved, and longer than the head (*Oryx*, Smith, in part).

The Oryx (*A. oryx*, Pallas).—As large as a Stag, with slender horns two or three feet long, straight, pointed, round, the basal third obliquely annulated, and smaller in the females. It is found northward of the Cape, and in the interior of Africa. The length of its hoof, which is greater than in the other species, enables it to climb rocks, and it prefers mountain districts.

The Algazel (*A. gazella*, Lin.; [*A. bezoastica*, H. Smith].—Inhabits North Africa, from Nubia to Senegal. It is often sculptured on the monuments of Egypt and Nubia; and M. Lichtenstein thinks that it is the true *Oryx* of the ancients. [The *A. leucoryx*, which is distinct, and *A. beisa*, require to be here added. Perhaps also the *Anoa depressirostris*, Auct.]

Fig. 61.—Oryx Antelope.

g. Horns annulated, with a simple curve, the points directed backward.

The Blue Antelope (*A. leucophæa*, Gm.).—A little larger than the Stag, of a bluish ash-colour; large horns in both sexes, uniformly curved, with more than twenty rings.

The Equine Antelope (*A. equina*, Geof.).—As large as a Horse, and reddish-grey, with the head brown, a white spot before each eye; a mane on the neck, large horns, &c. [A nearly allied species, of equal size (*A. nigra*), has lately been discovered in South Africa, the males of which are almost wholly black. We may here mention also the *A. ellipsiprymnus*, which is larger than a Stag, with a conspicuous white ring on the buttocks, and rather long coarse hair; which latter character is enhanced in *A. koba* and *A. sing-sing*.]

The *Cambing-outan*, or Antelope of Sumatra (*A. sumatrensis*, Shaw).—Size of a large Goat; black, with white hair on the neck and throat; the horns small and pointed. [The affinity of this species with the preceding is not obvious: it is more nearly allied to *A. thar* and *A. ghorral*.]

h. Horns encircled with a spiral ring.

The *Impoof* (*A. oreas*, Pall.).—*Elk* of the Cape colonists. As large as the largest Horse, with stout, conical, and straight horns, surrounded by a spiral ridge; greyish hair, with a small mane along the spine; a kind of dewlap under the neck; and tail terminated by a tuft. It lives in herds on the mountains, to the north of the Cape of Good Hope. [Allied to it is the *A. canna*, from the same locality, which is smaller and more slender.]

The Coudou (*A. strepsiceros*, Pal.)—Size of a Stag, with large horns in the male only, that are smooth with a triple curve, and a single longitudinal and slightly spiral ridge: a small beard on the chin, and a mane along the spine. This animal lives solitarily, to the north of the Cape of Good Hope.

of Guinea, which have also long tails, are distinguished by their long legs, very convex forehead, pendent ears, want of horns, and short coarse hair instead of wool. The Sheep of Northern Europe and Asia are mostly of small size, with a very short tail, [the truth being, that this appendage is merely cut short by the shepherds soon after birth]. Those of Persia, Tartary, and China, have the tail completely transformed into a double globe of fat. The Syrian and Barbary Sheep retain long tails, which are loaded with a vast mass of fat. In both the latter varieties, the ears are pendent, the horns large in the Rams and middle-sized in the Ewes and Wethers, and the wool is intermixed with hair.

Sheep are valuable for their flesh, suet, milk, skin, wool, and manure; the flocks, well managed, proving everywhere a source of fertility. The Lamb is weaned at two months, and sheds its milk teeth from the first to the third year. The Ewe propagates at one year, and is prolific for ten or twelve; its period of gestation is five months, and it often yeans two Lambs. The Ram, adult at eighteen months, suffices for thirty Ewes, and is enfeebled at eight years old.

THE OXEN (*Bos*, Linn.)—

Have horns directed laterally, inclining upwards or forwards in a crescent form; they are large animals, with a broad muzzle, heavy and massive body, and stout limbs.

The Common Ox (*B. taurus*, Lin.).—Specifically distinguished by its flat forehead, longer than broad, and round horns, placed at the two extremities of a projecting ridge which separates the forehead from the occiput. In fossil skulls, which appear to have belonged to this species in its original condition (the *Urus* of the ancients), these horns curve forwards and downwards; but in the numberless domestic varieties they vary exceedingly in size and direction, and are sometimes altogether wanting. The ordinary races of the torrid zone have all a lump of fat upon the shoulders, and there are some of these races not larger than a Hog. Every one is acquainted with the utility of these animals for labour, and with the value of their flesh, fat, milk, hide, and even horns. The Cow goes with young nine months, and produces at eighteen. The Bull couples at eighteen months or two years, and is useless at ten.

Fig. 64.—European Bison.

The European Bison, or *Aurochs*, (*Bos urus*, Gm.)—This species, which has been erroneously deemed the original stock of our domestic cattle, is distinguished by its convex forehead, broader than high, by the attachment of its horns below the occipital ridge, by the length of its legs, by an additional pair of ribs, by a sort of curly wool which covers the neck of the male, forming a short beard under the throat, and by its grunting voice. It is a savage animal, which at present finds refuge in the great marshy forests of Lithuania, of the Krapacs, and of Caucasus, but which was formerly spread all over temperate Europe. It is the largest of the European quadrupeds. [There is some reason for suspecting that the Caucasian or *Mountain* Bisons are not identical with those of Lithuania.]

The American Bison, termed *Buffalo* by the Anglo-Americans, (*B. bison*, Lin.).—The bony head very like that of the preceding, and similarly covered, together with the neck and shoulders, with frizzled wool, which becomes very long in winter; but its limbs and tail are shorter, [and it has yet another pair of ribs]. It inhabits all the temperate parts of North America, and reproduces with the domestic Cow.

The Indian Buffalo (*B. bubalus*, Lin.).—Originally from India, and brought into Egypt, Greece and Italy, during the middle ages. It has a convex forehead, longer than broad; the horns are directed backward, and marked in front by a longitudinal projection. This animal is difficult to tame, but very powerful, and prefers marshy places and coarse plants on which the Ox could not live. Its milk is good, and the hide very strong, but its flesh is not esteemed. There is a race of them in India, the horns of which include a space of ten feet from tip to tip; it is named *Arni* in Hindostan, and is the *Bos arni* of Shaw. [There would appear to be several different wild races, and many tame ones, varying much in size.]

The *Gyall*, or Jungle Ox (*B. frontalis*, Lambert),—resembles the Domestic Ox in most of its characters, but has horns flattened from before backwards, and no angular ridges. They are directed laterally and more or less upward, but not backward. It is a domestic race in the mountain districts of the north-east of India, and is perhaps derived from the intermixture of the Buffalo with the common species. [We suspect it rather to be allied to the original stock, if it be not really the latter, of the various humped breeds of India.]

The *Yak*, or Grunting Ox, (*B. grunniens*, Pal.)—A small species, with the tail completely covered with long hairs like that of a Horse, and a long mane on the back: its head appears to resemble that of a Buffalo, but the

horns have not been sufficiently described. This animal, mentioned by Ælian, was originally from the mountains of Thibet. Its tail constitutes the standard, still used by the Turks to distinguish their superior officers.

Fig. 65.—Cape Buffalo.

The Cape Buffalo (*Bos caffer*, Sparm.).—Very large horns, directed outward and downward and then turned upward, flattened, and so large at base that they nearly cover the forehead, leaving only a triangular space, the point of which is above. It is a very large and extremely ferocious animal, which inhabits the woods of Caffraria. [There are other African Buffaloes of inferior size, a female of one of which (*B. brachyceros*, Gray), or the Short-horned Buffalo, with very large ears and well-proportioned limbs, is now living in London.] Lastly,

The Musk Ox (*Bos moschatus*, Gm. [*Ovibos moschatus*, Blainv.]).—Horns approximated and directed as in the Cape Buffalo, but meeting on the forehead by a straight line: those of the female smaller and separated. The forehead convex, and extremity of the muzzle hairy. It stands low, and is covered with long hair, that reaches the ground. Tail extremely short. It diffuses more strongly the musky odour common to the whole genus, [and which is also particularly noticeable in the European Bison]. Inhabits the coldest regions of North America, where alone it has been seen, though its skull and bones are sometimes carried by the ice to Siberia.

THE NINTH ORDER OF MAMMALIANS,—

CETACEA,—

Consists of animals without hind-limbs: the trunk being continued by a thick tail, which terminates in a horizontal cartilaginous fin, while the head is connected to the body by so short and thick a neck, that no diminution of its circumference is perceptible: this neck consists of very slender cervical vertebræ, that are partly anchylosed or soldered together. The first bones of their anterior extremities are shortened, and the succeeding ones flattened and enveloped in a tendinous membrane, which reduces them to the condition of true fins. Hence the external form is absolutely that of fishes, except that the latter have the tail-fin vertical. They always therefore remain in the water; but as they breathe by lungs, they are compelled to return frequently to the surface to take in fresh supplies of air.* Their warm blood; ears that open externally, though by very small orifices; their viviparous generation, mammæ by which they suckle their young, and all the details of their anatomy, sufficiently distinguish them from fishes.

Fig. 66.—Swimming Paw of Whale.

* The larger species, however, will remain more than an hour beneath the surface: in reference to which faculty, these animals have capacious reservoirs for arterial blood along the dorsal region, and even within the head: hence, to oxygenate the great volume of blood required to store these cavities, they continue breathing for a certain regular period, at each time of coming to the surface for that purpose.—ED.

The brain is large, and its hemispheres well developed; that portion of the cranium which contains the internal ear is separated from the rest of the head, to which it only adheres by ligaments. There are never any external ears, nor hairs upon the body.

The form of the tail compels them to flex it from above downwards, to produce a progressive motion; and it greatly assists them in rising in the water.

To the genera hitherto included, we add others formerly confounded with the Morses, [and which have since, with still greater propriety, been placed subordinately to the great series of PACHYDERMATA]. They form our first family, or that of the

CETACEA HERBIVORA,—

The teeth of which have flat crowns, which determines their mode of life; and the latter induces them to leave the water frequently, to seek for pasture on shore. They have two teats on the breast, and hairy moustaches; two circumstances which, when observed from a distance as they raise the anterior portion of the body above water, may give them some resemblance to human beings, and have probably occasioned those fabulous accounts of Tritons and Sirens which some mariners pretend to have seen. Although, in the cranium, the bony nostrils open towards the summit, the orifices of the skin are pierced at the end of the muzzle. Their stomach is divided into four sacs, of which two are lateral, and they have a large cœcum.

THE MANATI (*Manatus*, Cuv.)—

Have an oblong body, terminated by a lengthened oval fin: their grinders, eight in number throughout, have square crowns, marked by two transverse ridges; there are no incisors or canines in the adult, but, when very young, there are two very small pointed teeth in the intermaxillary bones, which soon disappear. Vestiges of nails are visible on the edges of their swimming-paws, which they employ with some address in carrying their young; hence the comparison of these organs with hands, and the name of *Manatus* applied to the animals. From their manner of living, they are also called *Sea-cows*, &c.; and from their mammæ, *Mermaids*, &c.

The Manati (*Trichechus manatus*, Lin.),—Is chiefly found near the mouths of rivers, in the hottest parts of the Atlantic Ocean; and it does not appear that those of the American rivers differ specifically from those of Africa. They grow to the length of fifteen feet, and their flesh is eaten. [M. F. Cuvier, from examination of the crania, arrived at the conclusion that the African species (*M. senegalensis*, Adanson) was satisfactorily distinct; and a third, from the rivers of Florida, has since been distinguished by Dr. Harlan as *M. latirostris*.]

THE DUGONGS (*Halicore*, Illig.)—

Have grinders composed of two cones laterally united: the teeth implanted in the incisive bones continue to increase in length, till they become true pointed tusks, but are in great part covered by thick fleshy lips, that are bristled with moustaches. The body is elongated, and the tail terminated by a crescent-shaped flapper.

We know but of one species (*H. dugong*), which inhabits the Indian Ocean, and has been confounded by several travellers with the Manati. Like that animal, it has been named *Siren*, *Sea-cow*, &c. [There is reason to suspect the existence of several species of this genus; that of the Red Sea is described by M. Ruppell by the appellation *H. tabernaculus*.]

THE STELLERINES (*Rytina*, Illig.)—

Appear to have only a single composite grinder on each side, with a flat crown, and elevated ridges of enamel. Their swimming-paws have not even the little nails observable in the Manati. According to Steller, the first, and hitherto the only one who has described them, their stomach also is much more simple.

But one species is known, which inhabits the southern parts of the Pacific Ocean. [It is entirely covered with a thick rugged cuirass, formed of agglutinated hairs, like the hoofs of ungulated quadrupeds.

The second family, or the animals which constitute the

CETACEA ORDINARIA,—

Are distinguished from the preceding by the singular apparatus from which they have received the appellation of *Blowers*. As with their prey they necessarily engulf, in their

capacious mouths, a great volume of water, there required to be some method of getting rid of it; and accordingly it passes through the nostrils by means of a peculiar disposition of the *velum palati*, and is accumulated in a sac situated at the external orifice of the cavity of the nose, whence, by the compression of powerful muscles, it is violently expelled through a narrow aperture pierced on the summit of the head. It is thus that these animals produce those jets of water observed by mariners at so great a distance. Their nostrils, continually bathed in salt water, could not be lined with a membrane sufficiently delicate to enable them to perceive odours; hence they have none of those projecting laminæ observed in other animals: the olfactory nerve is in some wanting, and if there be any endowed with the sense of smell, it must be in a very slight degree. Their larynx, of a pyramidal form, penetrates into the posterior portion of the nostrils, to receive air and conduct it to the lungs, without the animal being obliged to raise its head and throat above water for that purpose: there are no projecting laminæ in the glottis, and the voice is reduced to simple bellowing. They have no vestige of hair*, but the whole body is covered with a smooth skin, under which [or more strictly, forming part of it,] is that thick layer of blubber abounding in oil, the principal object for which they are pursued.

The mammæ are placed near the anus, and their swimming-paws are incapable of grasping.

Their stomach has five and sometimes as many as seven distinct sacs; instead of one single spleen, they have several, that are small and globular. Those species which have teeth have them all conical and similar to one another; for they do not chew their food, but swallow it rapidly.

Two little bones suspended in the flesh, near the anus, are the sole remaining vestiges of posterior limbs.

Several have a vertical fin on the back, composed of a tendinous substance, but unsupported by bone. Their eyes, flattened in front, have a thick and solid *schlerotica;* and the teguments of the tongue are soft and smooth.

They may be subdivided into two small tribes: those in which the head bears the usual proportion to the body, and those in which it is immoderately large; the first comprehending the Dolphins and the Narwhals.

THE DOLPHINS (*Delphinus*, Lin.)—

Have teeth in both jaws, all simple, and nearly always conical. They are the most carnivorous, and, in proportion to their size, the most cruel of their order. There is no cœcum.

THE DOLPHINS, properly so called, (*Delphinus*, Cuv.)—

Have a convex forehead, and the muzzle, which forms a kind of beak in front of the head, more slender than the rest.

The Common Dolphin (*D. delphis*, Lin.).—The beak-like snout depressed, and armed on each side of both jaws with from forty-two to forty-seven slender, curved, and pointed teeth: it is black above, white below, and eight or ten feet in length. This animal, found in vast herds in every sea [?], and celebrated for the velocity of its movements, which sometimes precipitate it on the decks of vessels, appears really to have been the Dolphin of the ancients. The entire organization of its brain would seem to indicate the docility which they attributed to it.†

The Great Dolphin (*D. tursio*, Bonaterre.)—The beak short, broad, and depressed; twenty-one to twenty-four teeth on each side above and below, which are conical, and often worn down: some individuals are more than fifteen feet in length. It appears that they are found in the Mediterranean as well as in the Ocean [and, though seldom taken, on account of the extreme rapidity of their movements, they are not rare in the British seas. There are numerous others].

M. de Blainville separates from these first Dolphins, under the term

DELPHINORYNCHUS,—

Those species in which the snout, though elongated and slender, is not separated from the forehead by a distinct groove.

* Except in the genus *Inia*, d'Orbigny, wherein there are true moustaches.—ED.

† This animal must not be confounded with a fish (*Coryphæna Hippuris*), celebrated for its beautiful iridescent colours, which bears the same popular name.—ED.

One has been thrown upon our coasts (*D. micropterus*, Cuv.), remarkable for the small size and backward position of its dorsal fin; it attains a length of fifteen feet, and loses all its teeth at an early age. [Only a single specimen of this remarkable species has ever been obtained, which was cast upon the shore near Havre: its form is slender and elongated, and the head is externally attached to the body by a distinct neck. No teeth were discovered in either jaw in the recent state; but after the gums were removed, a few rudimentary teeth were found in the lower jaw, as often happens in the upper jaw of the Cachalots. This animal constitutes the *Aodon*, we believe, of Lesson.]

Another, which also sometimes occurs in our seas (*D. rostratus*, Cuv.), has a slender muzzle, externally all even with the head, and twenty-one teeth on each side of both jaws. Its dorsal is of the ordinary size.

The Soosoo of the Ganges (*D. gangeticus*, Roxburgh) should be separated from the foregoing, having the spiracle in a longitudinal line, and slender jaws swoln at the end. [Its teeth are thirty on each side above and below, and according to M. F. Cuvier, the long symphysis and the intermaxillary crests approximate it to the Cachalots.] It ascends very high up the Ganges, and is probably the *Platanista* of Pliny, [which might be adopted as its generic designation].

THE PORPOISES (*Phocæna*, Cuv.)—

Have no beak [the largeness of the front-head compensating for its non-extension], but a short muzzle, uniformly convex.

The Common Porpoise (*Delph. phocæna*, Lin.), compressed and trenchant teeth, of a rounded form, to the number of twenty-two or twenty-four on each side of both jaws; blackish above, the under-parts white. It is [one of] the smallest of the *Cetacea*, not exceeding four or five feet in length, and is very common in all our seas, where it associates in vast herds.

The Grampus (*D. orca* and *D. gladiator*, Auct.).—Large conical teeth, a little crooked, eleven on each side above and below, the posterior transversely flattened: body black above and white beneath; a whitish crescent-shaped mark over the eye; and the dorsal fin elevated and pointed. It is the largest of the Dolphin group, becoming from twenty to twenty-five feet in length; and is a cruel enemy to the Whale, which it attacks in troops, tormenting it till it opens its mouth, when they devour the tongue.

A smaller species is occasionally met with on our coasts (*D. aries*, Risso; [*Ph. griseus*, F. Cuv.]), which loses its upper teeth at an early age, and retains but few of the lower: its dorsal fin is less elevated and placed further backward than in the Grampus, which latter is the true *Aries* of the ancients. The *Epaulard ventru* of Bonaterre presents a similar form; but Hunter's specimen was eighteen feet in length, whereas the present species does not exceed ten.

[The species with globular heads compose the

GLOBICEPHALUS, Lesson.]

The Deductor, or *Ca'ing Whale* (*Delph. globiceps*, Cuv. [*Gl. deductor*, Scoresby]).—Head globular, with long and pointed swimming paws: attains a length of more than twenty feet; and is black, with a white streak from the throat to the anus. This species lives in troops of several hundreds, conducted by old males; and is sometimes thrown upon our coasts. It has from nine to thirteen teeth on each side above and below, but loses all of them with age. [A beautiful second species (*Gl. Rissii*) exists in the Mediterranean, and two others have been delineated and described.]

THE DELPHINAPTERUS, Lacepede,—

Merely differs from the Porpoises in having no dorsal fin. [This name has more recently been confined to such as have a beak like the Dolphins, the others constituting the

BELUGA, Lesson.

To the latter subdivision appertains]

The White Beluga (*Delph. leucos*, Gm.; *D. albicans*, Fabr.), with nine teeth on each side above and below, thick and blunt throughout; a yellowish-white skin; head externally convex like that of a Porpoise, [but more approaching to globular], and size that of a Grampus. It inhabits all the glacial seas, and sometimes ascends rivers to some distance. [Is occasionally met with on the British coasts.

To the restricted

DELPHINAPTERUS—

belongs]

The White-beaked Dolphin of Peron (*D. leucoramphus*, Per.; [*Delphinapterus Peronii*, Less.], an inhabitant of the Austral seas, the head of which is but slightly convex and rather pointed, and the muzzle, part of the swimming-paws, and all the under parts of the body, lustrous-white; the superior portion black. It has from thirty-eight to forty-two teeth on each side above and below.*

* M. Rafinesque speaks of a Dolphin with two dorsal fins [on which he bestows the appellation *Oxypterus*]; and M. M. Quoy and Gaymard saw one they have named *D. rhinoceros*, *Voy. de Freycinet*, ii. f. 21; but as they only saw it at a distance, and half-immersed in the waves, there may have been some optical delusion.

THE BOTTLE-HEADS (*Hyperoodon*, Lacep.)—

Have the body and muzzle nearly similar externally to those of the Dolphins properly so called, but the cranium is laterally elevated by vertical bony partitions: most usually there are found only two small teeth in the fore-part of the lower jaw, which do not always appear externally; the palate is studded with small tubercles, [and there is a small dorsal fin].

But one species is known, which attains a length of five-and-twenty feet, and perhaps more, [*Delph. edentulus*, Schreb.; *D. bulskopf*, Lacepede; *D. bidentatus*, Hunter; *D. Hunteri*, Desm.; the *Bottle-nosed Whale* of Hunter]. —It is taken in the British Channel and the North Sea, and is often designated *Baleine à bec.*

[THE DIODONS (*Diodon*, Lesson)—

Principally differ from the preceding in having a flattened forehead: their lower jaw is much larger than the upper, and convex.

There is a species in the Mediterranean (*Delph. Desmarestii*, Risso), fifteen feet in length; a specimen of which, or of another closely allied, was cast on shore on the coast of Scotland (*D. Sowerbii*, Desm. and Blainv.) Several others are said to belong to this subdivision.]

THE NARWHAL (*Monodon*, Lin.)—

Has no teeth, properly so called; but very long and slender-pointed tusks implanted in the intermaxillary bones, and directed in the line of the axis of the body. The form of their body and head greatly resembles that of the Porpoises, [and still more the Beluga, as noticed by Prof. Bell; the swimming paws being also remarkably small, and the dorsal fin wanting, as in the latter animal].

Only one species is known (*Mon. monoceros*, Lin.; [*Narwhalus microcephalus*, Bonat., Lacep., Desm.]), the tusk of which, grooved spirally, and sometimes ten feet long, was formerly termed the horn of the *Unicorn.* This animal possesses the germs of two tusks, but it is seldom that both become equally developed. That on the left side usually attains its full growth, while the other remains permanently concealed within its socket, its developement having been prevented by its interior cavity becoming too rapidly filled with the deposition of ivory, which thus obliterates its gelatinous core. According to the description of the Narwhal, it is scarcely more than twice or three times the length of its tusk; the skin is marbled with brown and whitish; it has a convex muzzle, small mouth, spiracle placed on the top of the head, and no dorsal fin, but merely a projecting crest the whole length of its spine. The teeth are sometimes found perfectly smooth.

[We may here mention, at the conclusion of the *Cetacea* with moderate-sized heads, an extremely remarkable genus,—

THE INIA, d'Orbigny,—

Which has the external form of the Dolphins, properly so called, with some coarse bristly hairs on the snout: the spiracle is placed far backward, above the swimming-paws; the lips are deeply cleft to beneath the eye; and there is a small dorsal fin, and proportionally large auditory aperture.

The only species known (*I. Boliviensis*, d'Orb.) is remarkable for occurring thousands of miles from the sea, appearing to inhabit only the remote tributaries of the Amazons, and the elevated lakes of Peru: the singular character of possessing bristly hairs on the snout has also been observed in them when very young. This species has large swimming-paws, and thirty-four teeth on each side above and below, all of them rough, marked with deep and interrupted furrows, and of an irregular mammalory shape behind, which is very peculiar. A female specimen measured seven feet long, and the males are stated to be double that size: colour variable, commonly pale blue above, passing into a roseate hue beneath. It comes more frequently to the surface than the marine species, and is generally met with in troops of three or four individuals.]

The remaining *Cetacea* have the head so very large, as to constitute one-third or even half the entire length; but neither the cranium nor the brain participates in this disproportion, which is wholly due to an enormous developement of the bones of the face.

THE CACHALOTS (*Physeter*, Lin.),—

Are *Cetacea* with a most voluminous head, excessively enlarged, particularly in front; in the upper jaw of which there are neither teeth nor baleen (*whalebone*), or, if any of the former, they are small, and not projecting beyond the gum; but the lower jaw, straight, elongated, and corresponding to a groove in the upper one, is armed on its two sides with a row of cylindrical or conical teeth, which enter into corresponding cavities of the upper jaw when the mouth is closed. The superior portion of their enormous head consists almost entirely of large cavities, separated and covered by cartilages, and filled with an oil that becomes concrete on cooling, well known in commerce by the name *spermaceti*, a

substance for which they are principally hunted, as the body does not yield a large proportion of blubber: these cavities, however, are very distinct from the true cranium, which is rather small, is placed under their posterior portion, and contains the brain as usual. It appears that cavities filled with this spermaceti, or *adipocire* as it is called, are distributed to several parts of the body, communicating with those which fill the mass of the head; they even ramify through the external fat or blubber. The odorous substance known by the appellation *ambergris* appears to be a concretion formed in the intestines of the Cachalots, particularly during certain states of disease, and, it is said, chiefly in the cœcum.

The species of this genus are by no means well determined. That which appears most common, the *Ph. macrocephalus* of Shaw and Bonaterre, but not of Linnæus, has a mere callous prominence instead of a dorsal fin; there are from twenty to twenty-three teeth on each side of the lower jaw, and small conical ones hidden beneath the gum in the upper: its blow-hole is single, and not double as in the greater number of *Cetacea;* neither is it symmetrical, but is directed towards the left, and terminates on that side on the front of the muzzle, which latter is truncate.* In addition to this, it is stated that the left eye is often smaller than the other, for which reason the whalers endeavour to attack it on that side. This species must be very extensively distributed, if, as is asserted, it alone furnishes the whole of the spermaceti and ambergris of commerce, for these substances are brought from both the north and south. Cachalots without a dorsal fin have even been taken in the Adriatic.

THE PHYSETERS, Lacepede,—

Are Cachalots with a dorsal fin.

Two species only have been distinguished (*microps*, and *tursio* or *mular*), and those merely by the equivocal character of having the teeth curved or straight, blunt or pointed. These animals are found both in the Mediterranean and glacial seas, in the latter of which they are reputed to be cruel enemies to the Seals.

THE WHALES (*Balæna*, Lin.)—

Equal the Cachalots in size, and in the proportional dimensions of the head, although the latter is not so much enlarged in front; but they have no teeth whatever [beyond the rudiments of them in the fœtal state]. The two sides of their upper jaw, which is keel-shaped, are furnished with thin, transverse, serrated laminæ, termed *baleen* or *whalebone,* composed of a sort of fibrous horn fringed at the edges, which serve to retain [and strain from the water] the minute animals on which these enormous cetaceans feed. Their inferior jaw, supported by two osseous branches arched outwardly and upward, without any armature, affords lodgment to a very thick and fleshy tongue, and, when the mouth is closed, envelopes all the internal part of the upper jaw and the baleen with which it is invested. These organs do not allow Whales to feed on such large animals as their vast size would lead to imagine. They subsist on fish, but principally on worms, mollusks, and zoophytes, and it is said that they chiefly take the very smallest, which become entangled in the filaments of the baleen. Their nostrils, better organized for smell than those of the Dolphins, have some ethmoidal laminæ, and appear to receive some small olfactory nervous filaments. They have a short cœcum.

The Great Northern Whale (*B. mysticetus*, Lin.) was long considered to be the largest of known animals, but it appears from the recent observations of Capt. Scoresby, that it scarcely ever exceeds seventy feet in length, which the Rorquals or Whales with wrinkled bellies frequently surpass. It has no dorsal fin. To procure its blubber, often several feet in thickness, and yielding an immense quantity of oil, whole fleets are annually equipped in pursuit of it. Formerly bold enough to venture into our seas, it has gradually retired to the far north, where the number is daily diminishing. Besides its oil, it furnishes the black and flexible *whalebone* of commerce, the pieces of which are eight or ten feet long, and to the number of eight or nine hundred on each side of the palate. A hundred and twenty tons of oil are obtained from a single individual. Shelled Mollusks attach themselves to its skin, and multiply there as upon a rock; the *Balanus* family even penetrate into it. The excrement is of a fine red colour, and affords a tolerable dye. There is a very similar species in the Antarctic seas.

Other species,

THE RORQUALS (*Balænoptera*, Lacepede),—

Have a dorsal fin, and are subdivided according as the belly is smooth or wrinkled. [As the former section is unquestionably founded in error, as suspected by Cuvier†, we pass to those] which have the throat and under-parts wrinkled with deep longitudinal folds, and consequently susceptible of great dilatation, the intent of which, in their economy, is yet unknown.

* We have verified on two crania this want of symmetry in the spiracle, announced by Dudley, Anderson, and Swediauer, which induces us to credit the inequality of the eyes mentioned by Egède.

† The wrinkled belly being simply filled out with water.

There are two in the European seas, viz.,—the Great Rorqual (*Bal. boops*, Lin.),—superior in length to the common Whale, and shunned on account of its extreme ferocity, and the small quantity of its oil; and the Small Rorqual (*Bal. musculus*, Lin.), which differs from the other [in its very inferior size, in its proportions, and number of vertebræ. There is a third in the southern seas, and also a distinct fossil species.

On proceeding to determine the fixed analogies of the teeth throughout the different groups of *Mammalia*, we have arrived (since most of the foregoing pages were *stereotyped*) at the conclusion, that no *placental* mammalian has more than three pairs of incisors, or three pairs of true or persistent molars, (normally,) in either jaw; all seeming exceptions being reducible to this general proposition: whereas the *Marsupials* have normally four of each, and some even five. By *persistent* molars, are intended those which are not preceded by *milk-teeth.*

Following, then, the indications afforded by the structure of the molars, (which we conceive to furnish the most available guide to sound classification,) we are next led to recognize two principal varieties of dentition among the *Placentalia*, to one or the other of which every observed modification may be definitively referred. These two varieties are characteristic of a great *zoophagous* type and a great *phytophagous* type.

Where exceptions occur in the former instance, the amylaceous parts of vegetables, as fruits, seeds, and farinaceous bulbs or roots, are almost exclusively resorted to; and animal products are preferred to the composition of the recent carcass in those few exceptive cases which, in a trivial degree, affect the latter generalization.

The zoophagous type of dentition is obviously of a higher grade than the other, and the animals in which it occurs require more nutritious aliment.

Throughout the zoophagous division, the molars are compact in texture, and the enamel never dips into their substance; the basal growth of the teeth (except the pseudo-incisive canines only, in the very singular genus *Cheiromys*,) ceases upon the latter attaining their required size; in consequence of which they gradually wear down by attrition, till in aged animals they are not unfrequently reduced to stumps.

In the *phytophagous* division, the molars are much less compact, and the enamel generally dips into their substance in various ways; the teeth are commonly furnished with persistent formative pulps, which deposit fresh substance at their base as their crowns wear away, so that they continue permanently growing. The exceptions that occur to this general definition do not intrinsically affect the distinctness of the present group from the other, and are easily understood, so that a transverse section of a molar (known to be that of a placental animal) will suffice in every instance for the determination to which it belongs.

These two great divisions somewhat analogously subdivide each into two sections, which differ considerably in the general details of their organization, and most commonly in the structure of the teeth. They may be regarded as *normal* and *abnormal* sections.

In the normal sections of the zoophagous and phytophagous grand divisions of *Placentalia*, the four sorts of teeth—incisors, canines, renewed and persistent molars—are generally present, or at least three sorts of them, each characterized by a particular form and structure different from the rest. In the abnormal sections, the teeth are commonly much more numerous, and alike in structure, and consist principally or even wholly of false molars; all of them are without exception single-rooted.

We might consider these four sections as *Orders*, and denominate them as follow.

A. *Zoophagous type.*

1. *Typodontia.* Normal: comprehending the *Bimana*, *Quadrumana*, and *Carnassiers* of Cuvier.
2. *Isodontia.* Abnormal: consisting of the *Cetacea* of Cuvier, divested of the herbivorous subdivision.

B. *Phytophagous type.*

3. *Diplodontia.* Normal: comprising the *Pachydermata*, *Cetacea herbivora*, *Rodentia*, and *Ruminantia* of the same naturalist.
4. *Aplodontia.* Abnormal: corresponding to the *Edentata* of Cuvier, divested of the *Monotremata.*

These together constitute the *normal* or placental subclass of *Mammalia;* and the *abnormal* or ovo-viviparous subclass might range in two orders only, viz.:

5. *Heterodontia.* Normal: or the *Marsupiata:* and
6. *Pseudodontia.* Abnormal: or the *Monotremata.*

The *Typodontia* primarily subdivide into the *Primates* and *Feræ* of Linnæus, or *Secundates*, as the latter has recently been termed by De Blainville.

The *Primates* are characterized by the external distinctions popularly known, and also, it may be added, by their hair being of one sort only, having never any softer felt beneath it.* They separate into *Cheiropoda* and *Cheiroptera.*

The *Cheiropoda* comprise the *Bimana* and *Quadrumana* of Cuvier, but not the marsupial handed animals, included under this name by Mr. Ogilby. They have never more than four incisors in either jaw, invariably possess a cœcum, have no *os penis*, and are born with the eyes open. They subdivide into *Anthropida* and *Lemuria.*

The *Anthropida* are characterized by the general form of the head, the complete separation of the orbits from the temporal fossa by a bony partition, by having the incisors broad and contiguous, and vertical, or nearly so, in both jaws, by their anthropoid molars, &c. Their teeth form an even series, the continuity of which is only broken by the interspace required for the reception of the opposite canine; and in Man only, where the canines are not lengthened beyond the other teeth, even this vacuity does not occur. They fall into the *Catarrhini* and *Platyrrhini* of Geoffroy, according to the number of *false* molars; and the circumstance of their being respectively peculiar to the Old and New Worlds, affords a presumptive argument that the human genus, which pertains strictly to the former, is not indigenous to America.

* We were deceived by certain appearances in stating that exceptions to this rule existed, at pp. 45, 48.

The *Lemuria* are mostly distinguished by a vulpine muzzle, with separated incisors in the upper jaw, those of the lower directed horizontally forward, as are also the inferior canines, which the author reckoned as a third pair of incisors. Their cheek-teeth are often sharply tuberculated; and the doubling down of the ears in some, the character of the fur, the particular structure of the female reproductive organs, nocturnal habits, and a variety of other characters, forcibly recall to mind the insectivorous Bats. Among them, the genus *Cheirogaleus* is remarkable for the total absence of superior canines; and that of *Cheiromys* for having rodent canines, which pass through the intermaxillary bones, and supply the place of incisors, which are altogether wanting.

The *Cheiroptera* have never more than four incisors to the upper jaw, but commonly six below, which is the normal complement. Amongst their less obvious distinctive characters from the other *Primates*, may be mentioned the constant absence of any cœcum, and the presence of a small *os penis* within the *glans*, but different from that of ordinary occurrence among the *Secundates*. They are born with their eyes closed. Following the fancy of Linnæus in applying the name *Lemur* to the preceding group, we propose to designate the two principal divisions of *Cheiroptera*,—*Harpydia* and *Spectra*, which, in various respects, are analogous to the *Anthropida* and *Lemuria*.

The *Harpydia* have blunt molars, an extremely elongated stomach, and long intestines; also a sonorous voice, and most usually a claw to the fore-finger. Though stated to feed, in some instances, partly on insects, we have reason to believe (from recent observation of a living animal, which invariably rejects all insect-food that is offered to it,) that they are exclusively frugivorous. All are peculiar to the eastern hemisphere.

The *Spectra* have a globular stomach, short intestines, and sharp tubercles to the molars, except in the very extraordinary genus *Desmodus*, which, for reasons connected with its habits, has no true molars whatever. They have a clicking voice, and no claw to the fore-finger, &c.

The second sub-order of *Typodontia*, or the *Feræ*, or *Secundates*, subdivides into the obvious groups *Carnivora* and *Insectivora* of Cuvier; but as these names are equally applicable to Marsupial genera, and therefore particularly liable to mislead, by inducing the erroneous supposition that they apply to all carnivorous and insectivorous *Mammalia* respectively, in which significant general sense they might still be employed with convenience, just as the analogous terms *Herbivora* and *Frugivora* are at present, we believe that they might advantageously be disused in their restricted and forced meaning, to be superseded by names of more special application. We therefore venture to designate them *Cynodia* and *Ecanina*. It is in this division that the four different sorts of teeth assume their most distinctive characters, as it is unnecessary to dwell upon. The incisors are rarely less than six in number, in either jaw.

In the *Cynodia*, the canines are always present, both above and below, and are invariably strongly characterized as such; and the incisors form a transverse range, the outer pair, more particularly those above, being always largest, and the medial smallest. They fall into four subtribes, viz., *Digitigrada*, *Subplantigrada*, *Plantigrada*, and *Pinnigrada;* the first and last of which are constantly furnished with a cœcum, which does not occur in the others.

The *Digitigrada* are not always digitigrade, but the term need not on this account be altered. We adopt the group as instituted by Cuvier, detaching only the first leading subdivision, or that of the Weasels and allied genera.

The *Subplantigrada* have never more than one true molar above, and another below, which vary exceedingly in developement, in an inverse ratio to the *carnassier*, or *scissor-tooth*,—the Weasels and Badgers exhibiting the extremes. The great and small intestines scarcely differ in calibre; and all, unless the Otters constitute an exception, can diffuse at will a disgusting stench. None of them fall into a torpid state during the winter, like the northern *Plantigrada*. Their hind feet are always semi-plantigrade, but none of them bring the heel quite to the ground.

The *Plantigrada* have constantly two pairs of true molars in each jaw, which likewise vary exceedingly in developement, and in an inverse ratio to the scissor-teeth, which in the Bears are reduced to their minimum throughout the *Cynodia*. In their plantigrade gait, and generally naked sole (not naked by friction merely, as in the Badgers), their tendency to torpor during severe weather, and a variety of other particulars, a direct affinity to the *Insectivora*, Cuv., is very apparent; and the Raccoons among them are further remarkable for the entire separation, and a certain amount of prehensibility of the toes, which last enables them to clasp small objects in a manner observed in no other *Secundates*,—the rest of the *Cynodia* having a membrane more or less developed between the toes. The skull of the Bears exhibits various tokens of affinity with the next group.

The *Pinnigrada*, or Seals, correspond to the *Amphibia* of Cuvier, and are remarkable for the similarity of their true and false molars; the former of which, however, in no instance, exceed the typical number.

The *Ecanina*, or second and abnormal subtribe of *Secundates* (being the *Insectivora*, Cuv.), have an attenuated muzzle, and mostly separated incisors that face laterally, the *medial* or foremost being always largest, as in the *Primates;* no true upper canines, but very commonly an enlarged false molar with two fangs, that presents the appearance and performs the office of a canine, the lower canines being always present (unless in the Shrews), but commonly very small, and hence ranked as a fourth pair of incisors. They have generally three true molars, both above and below, and always perfect clavicles, which is the case in no species of *Cynodia*. The genera *Macroschelides* and *Tupaia* alone possess a cœcum; and the Shrews, which have no incisors, nor even intermaxillary bones that should contain the upper ones, are remarkable for possessing two very curious front teeth, which we suspect are modified false molars.

We shall offer no further remarks on the Isodontia, or *Cetacea ordinaria* of Cuvier, than to observe, that the Narwhal alone among them possesses other than false molars.

The Diplodontia, or normal order of the great phytophagous type, divides first into *Brochata* and *Ungulata*, the names of which require to be admitted with some reservation, though certainly not with more than—nor indeed so much as—the *Edentata* of Cuvier. They have always a voluminous cœcum, with the single, and consequently very remarkable, exception of the small Dormouse group.

The *Brochata* have ordinarily (at least the three first principal divisions of them) permanently growing canines, which either pass through the intermaxillaries, as in the Elephants and Rodents—*deriving their nutriment*, how

ever, from within the true maxillaries—or they are directed outwards, as in the Pigs and Hippopotami. The composite structure of the molars, from which this order takes its name, attains its most remarkable developement in the present division, as observed in the Elephant, the Capybara, and the Phascochœre. They have rarely fewer than four, and often five distinct toes on each foot; and generally a cleft upper lip, less observable when the nose is prolonged into a snout, or proboscis. They separate into *Proboscidia, Rodentia, Chœrodia,* and *Syrenia.*

The close affinity of the *Proboscidia* and *Rodentia* was distinctly pointed out and descanted upon by Cuvier in his *Ossements Fossiles*, to which valuable work the reader is necessarily referred, from want of space to enlarge upon the subject here. The tusks of the *Proboscidia* are mostly peculiar to the upper jaw, where they attain enormous dimensions, being small when present in the lower one. Their form is cylindrical, with conically-pointed tips, and they are surrounded with enamel.*

The *Rodentia* have approximated tusks in both jaws, with enamel only in front; and the Hares alone among them possess true incisors in the upper jaw only, in front of which the tusks pass, protruding in their usual site throughout the group. They have neither an elongated snout nor a proboscis; and their extremities are unguiculated. In the Hare, which has six rootless molars, the three first alone are preceded by rooted milk teeth; and the anterior molar, in numerous other genera, the adults of which have four, is in like manner preceded by a deciduous rooted tooth, which is shed about the time the last posterior molar protrudes through the gum.

The *Chœrodia* have always incisors, their tusks, of similar kind to those of the two preceding groups, being directed outwards, and those of the upper and lower jaws generally rubbing against each other. The Swine and Hippopotami are characteristic examples; and we are disposed to refer to this division (as a distinct minor group), the very singular genus *Hyrax*, the adults of which do not possess canines.

Lastly, the *Syrenia*, or *Cetacea herbivora*, Cuv., which have no posterior extremities, like the *Isodontia*, are likewise deprived of canines, at least the existing genera; for the *Deinotherum* (assuming that this lost genus is correctly placed here) had enormous tusks in the lower jaw only, anomalously turned downward. Their general anatomy leaves no doubt of the propriety of separating them altogether from the *Isodontia*, or zoöphagous *Cetacea*, and allies them (we consider) most nearly to the *Chœrodia*.

The *Ungulata*, or grazing animals, divide, according to the simple or complex stomach, into *Bellua* & *Ruminantia*

The *Bellua* consist of the Horses, Tapirs, Rhinoceroses, and proximate fossil genera; all of which now existing have a prehensile upper lip more or less developed, the nostrils being prolonged with it into a short flexible proboscis in the Tapirs, and there is reason to conclude in many of the extinct forms. The true and false molars present no sensible difference in the adult animal; but the dentition of the young proves that the normal complement of true molars is not exceeded.

The *Ruminantia* fall into *Ancerata* and *Pecora*; the former consisting of the Camels and Llamas, which have a cleft and prehensile upper lip, and claw-like hoofs upon which they do not rest; and the latter of the remainder, which have the upper lip entire and non-prehensile, (the tongue becoming so in its stead,) and the ends of their toes encased in hoofs, upon the soles of which the weight of the body is supported. The former alone possess any superior incisors, though only one pair; but all have six incisors in the lower jaw, together with inferior canines, which in the *Pecora* assume the form and direction of incisors, but the true analogy of which appears on com parison of them with the lower canines of either the *Bellua* or *Ancerata*, and of the Bactrian or Two-humped Camel in particular, which has no interspace (as in the others) between its lower canines and incisors.

The Aplodontia, or abnormal division of the phytophagous type, corresponding to the *Edentata* of Cuvier, is now in course of becoming unexpectedly elucidated by the extraordinarily rapid discovery of fossil genera in South America, which present a more complicated form of molar tooth than was previously known in this division, as exemplified by the newly established genera *Mylodon, Glyptodon*, and we venture to suggest — *Toxodon*, wherein the indentations of the enamelled sides of the teeth resemble those of many rodents. However numerous may be the *false* molars in certain genera of this division, the number of their true molars appears in no instance to exceed three, (at least in those which we have been able to examine, comprehending all with the unfortunate exception of *Priodon*); and the structural distinction between their true and false molars is sufficiently evident.

Of the two Ovo-viviparous orders, there is only space left to remark, that whereas the Placental *Carnivora* and *Herbivora* are (as we have seen) modified upon two distinct types, which do not pass into each other, the Marsupial *Carnivora* and *Herbivora* pertain to the same equivalent type, and grade into each other so that an analogous line of rigid demarcation cannot be traced. This perhaps may be added to the various indications of their abnormity as a group, as compared with the preceding or Placental subclass of *Mammalia*.

In conclusion, it may here be noticed, that without intending any thing of the kind while gradually ascending to the foregoing classification, it has so happened that species with superior intelligence in conformity with their cerebral developement are placed at the head of each principal group, which may or may not be fortuitous coincidence. Thus, Man ranks at the head of the most highly organized order—*Typodontia*, the Dolphin at the head of the *Isodontia*, and the Elephant at that of the great phytophagous division, and, consequently, of the *Diplodontia*; while the Dog ranges first among the *Secundates*, and the Horse first of the *Ungulata*. The leading genus of the *Aplodontia* may yet remain to be discovered. The animals here mentioned (at least the terrene kinds, for of the Dolphin we do not possess the requisite data for forming an opinion), certainly appear to possess more eminently culturable intellects than any others, such as may be applied to purposes having no relation to their natural habits; and Man has accordingly been enabled to gain them as assistants in his various labours and occupations.]

* It may be that the *Proboscidia* supply an exception to the otherwise universal rule of placental *Mammalia* having never more than three pairs of true molars in either jaw; but we suspect that such seeming exception would upon analysis prove to be more apparent than real, the last of them being probably analogous to the teeth which human beings sometimes develope when in vigorous senility; theoretically, a renewal of their predecessors.

THE OVIPAROUS VERTEBRATES IN GENERAL.

Although the three classes of Oviparous Vertebrates differ very much from each other in their quantum of respiration, and in all that relates to it, viz., the power of movement and the energy of the senses, they present several characters in common when opposed to the *Mammalia*, or Viviparous Vertebrates, [certain of which are participated in by the Ovoviviparous Mammalia, or the subclass of ***Marsupiata*** and *Monotremata*].

The hemispheres of the brain are much reduced, and [as in the Ovoviviparous Mammalia] are not united by a *corpus callosum;* the *crura* of the *cerebellum* do not form that protuberance called the *pons Varolii;* the *nates* (at least in two of these classes) attain a great development, are hollowed so as to enclose a ventricle, and [as in the Ovoviviparous Mammalia] are not covered by the hemispheres, but are visible below or on the sides of the cerebrum, [which last statement does not apply to the Ovoviviparous Mammalia]: their nostrils are less complex; the ear [as in the *Monotremata*] has not so many small bones, which in several are totally wanting; the cochlea, where it exists, which is only the case in Birds, is much more simple, &c. Their lower jaw, always composed of many pieces, is attached by a concave facet to a salient process, which belongs to the temporal bone, but is separated from its petrous portion: the bones of the cranium are more subdivided, though they occupy the same relative places, and fulfil similar functions; thus, the frontal is composed of five or six pieces, &c. The orbits are merely separated by an osseous lamina of the sphœnoidal bone, or by a membrane. When these animals possess anterior extremities, in addition to the clavicle, which is often united to its fellow on the opposite side, and is then termed *fourchette*, the scapular also rests upon the sternum, by means of a very large and prolonged coracoid apophysis. The *larynx* is more simple, and has no *epiglottis;* the lungs are not separated from the abdomen by a perfect diaphragm, [except in the single instance of that extraordinary bird, the *Apteryx*], &c. But in order that these various relations should be adequately appreciated, it would be necessary to enter into anatomical details, which do not belong to this first part of our work. It is sufficient to have here pointed out the mutual analogy of the *Ovipara*, which, in reference to the plan on which they are constructed, is greater than that of any of them with the Mammalia.

Oviparous generation consists, essentially, in this; that the young animal is not attached by a *placenta* to the parietes of the uterus, or of the oviduct, but remains separate from it by its most external envelope, [all which applies to the Ovoviviparous Mammalia]. Its aliment is prepared beforehand, and enclosed in a sac attached to its intestinal canal; being what is termed the vitellus, or yolk of egg, of which the young animal is a sort of appendage, at first imperceptible, which is nourished and augmented by absorbing the fluid of the yolk. Such of the *Ovipara* as breathe by lungs, have the egg furnished with a highly vascular membrane, which appears to serve for respiration; it is connected with the bladder, and represents the allantoid of Mammalia. This membrane is neither found in Fishes, nor the Batrachians; which latter, when young, respire in the manner of Fishes, by gills or *branchiæ*.

Many of the cold-blooded *Ovipara* do not bring forth their young until they are developed and extricated from their shell, or other membranes which separated them from their parent. These are called *false Ovipara.*

THE SECOND CLASS OF VERTEBRATED ANIMALS.

THE BIRDS (*AVES*),—

Are oviparous vertebrates with double circulation and respiration, [mostly] organized for flight.

Their lungs, undivided and attached to the ribs, are enveloped by a membrane pierced with large holes, and which allows the air to pass into many cavities of the chest, the abdominal region, arm-pits, and even of the interior of the bones* ; so that the ambient fluid not only bathes the surface of the pulmonary vessels, but also that of an infinitude of vessels traversing the rest of the body. Thus Birds respire, in certain respects, by the ramifications of their aorta, as well as by those of their pulmonary artery, and the energy of their irritability is in proportion to their amount of respiration.† Their total conformation is arranged to participate in this energy.

Their anterior extremities, destined to sustain them in flight, could neither serve them for standing, nor for clutching : they are bipeds, then, and pick up objects from the earth with their mouth ; their body, consequently, is balanced upon the legs ; the thighs are directed forward, and the toes are lengthened to form a sufficient base for standing. The pelvis is longitudinally much extended, to furnish attachment to the muscles which support the trunk upon the thighs : there is even a suite of muscles proceeding from the pelvis to the toes ; and passing over the knee and heel, so that the simple weight of the bird flexes the toes : it is thus that they are enabled to sleep perched on one foot. The *ischia*, and especially the *ossa pubis*, are lengthened out behind, and widened in their span, to allow the necessary space for the developement of the eggs.

Fig. 67.—Skeleton of Jer Falcon.

The neck and the beak are elongated to reach the ground ; but the former has also the requisite flexibility for doubling backward when at rest. It has therefore numerous vertebræ, [varying from twelve to twenty-three, which latter number is attained only in the genus *Cygnus*]. The trunk, on the contrary, which serves as a fulcrum to the wings, has but little mobility ; the sternum especially, to which are attached the muscles which effect the propulsive stroke in flying, is of great extent, its surface [except in the Ostrich and allied genera, which do not fly,] being further augmented by a projecting ridge along its middle. It is [mostly]

* In the Hornbills, even the phalanges of the toes are hollow, and communicate with the lungs. The opposite extreme occurs in the *Apteryx*, which has no accessory air-cavities.—ED.

† *Two Sparrows consume as much air as a Guinea-pig.*—LAVOISIER, *Mémoires de Chimie*, i. 110.

composed originally of five pieces : one medial (fig. 68, *a*), of which this salient lamina [known as the sternal crest, ridge, or keel] constitutes a part; two triangular anterior lateral [termed costal processes] (*b*), for the attachment of the ribs; and two forked posterior lateral (*c*), for the extension of its surface; and the greater or less degree of the ossification [that is to say, obliteration] of the notches of these last, and the extent of the interval which is left between them and their principal bone, denote the relative amount of vigour of flight in Birds. The [Eagles, Harriers, (the Falcons much more slowly, if indeed at all), and some other] diurnal Birds of prey, the Swifts and the Humming-birds, [the Parrots, and also the Storm-petrels,] lose, as they grow old, all traces of these unossified spaces. [In the Ostrich and its allies, the sternum is composed originally of only two pieces; and the number likewise varies in those Birds which possess a sternal crest.]

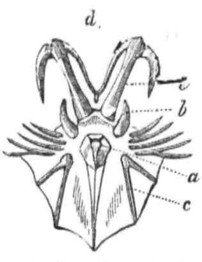

Fig. 68.—Sternal apparatus of a newly-hatched Chick.

The fourchette [*furcula*, or "merry-thought" bone], (fig. 68, *d*), produced by the junction of the two clavicles, and the two stout abutments formed by the [huge] coracoid aphophyses (*e*), keep the shoulders apart, notwithstanding the opposing force exerted by the action of flying; the fourchette, in particular, is commonly more stout and open, according as the flight of a Bird is vigorous.* (See fig. 67.) The wing, supported by the humerus (fig. 69 *a*,) fore-arm (*b*), and hand, which is elongated, and exhibits one digit and the rudiments of two [or (including the winglet *o*,) three] others (1, 2, 4) is furnished throughout its length with a range of elastic quills, which greatly extend the surface that resists the air. The quills adhering to the hand are named *primaries*, and these are [almost] always ten in number†; those attached to the fore-arm are called *secondaries*, but their number varies; weaker feathers attached to the humerus are styled *scapularies* [*tertiaries;* the true *scapularies* constituting that separate range which grows over the *scapulars*, or "shoulder-blades"]; and the bone which represents the thumb‡ (*o*), is also furnished with what are designated bastard quills, [this member being generally termed *alula spuria*, or *winglet*]. Along the base of the quills is a range [and successive ranges] of feathers named *coverts* [both on the outer and inner surfaces of the wing, which receive corresponding appellations to those of the quill-feathers they impend, as *primary coverts*, &c., and are further distinguished as *greater*, *lesser*, and *least*].

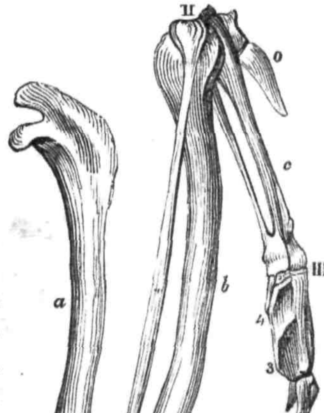

Fig. 69.—Jer Falcon's Wing.

* In the instance of the Parrots, some of which are birds of very strong flight, although the coracoids are always very stout (much resembling those of the Hawks), the furcula is never strong, and is peculiarly flattened, so that its resisting force is thus considerably diminished. Some Parroquets, indeed, as those small ones popularly termed Love-birds (*Agrapornis*), have no furcula whatever; and it is worthy of being noticed that the restricted Toucans (*Rhamphastos*) have the clavicles separate and very short, forming small dagger-shaped appendages, the use of which is not obvious.—ED.

† In the Grebe genus, eleven many of the singing birds have the first extremely minute; and, in the Starling and some others, it is, analogically speaking, wanting; so that the number is in these reduced to nine.—ED.

‡ As on the removal of digits, that of the thumb is found to be invariably the first, the rudimentary finger above referred to is now considered as analogous to the index finger of the human hand: the thumb, however, being sometimes represented by a bony spine, as the spur of a common fowl represents the first digit of the foot.—ED.

The bony tail is very short, [and consists in most instances of nine vertebræ, the three last of which are commonly anchylosed into a plough-share form, and are generally collectively styled the *coccyx*], but has a range of strong feathers, which, when spread out, assist in supporting the bird: their number is ordinarily twelve; sometimes fourteen, and in many of the *Gallinaceæ* eighteen; [in some few genera, as the Grebes, Nandou, &c., these are wanting altogether; a single Humming-bird (*Trochilus enicurus*) possesses only six; the Ani eight; the rest of the Humming-birds, and various others, ten; while the Swans present from eighteen to twenty-two. The two central of these feathers are implanted above the even line formed by the insertion of the rest, and essentially correspond to the wing-tertiaries, as the others do to the wing-secondaries; the latter being in no instance moulted more than once in the year, the former in many instances twice: we might accordingly designate the two central tail feathers, which differ conspicuously from the rest in structure, *uropygials*. Above and below the tail are lengthened feathers, commonly of weak texture, known as the *upper* and *under tail-coverts*.

The rest of the feathers of Birds are named from their position, as *frontal, coronal, occipital, nuchal, dorsal* or *interscapulary*, which together form a continuous series, apart from the *scapalaries*; those in front of the eye are termed *loral*,and the auditory aperture is covered by a range styled *auriculars* or *ear-coverts*: the sides of the neck and medial portion of the sternal and abdominal region are at most covered with down; the former being concealed by the lateral feathers of the fore and hind neck meeting; the latter by a similar junction of two distinct lateral ranges. As it is necessary that the warm body of a bird should be in actual contact with the eggs during incubation, whatever down may cover the medial inferior region disappears in the females towards the season of propagation, even in those confined in cages, so that this bareness is not produced mechanically. Finally, besides various accessory tufts in different genera, some long slender feathers are situate at the base of the wing internally, which are named *axillaries*].

The legs have a femur, a tibia, and a peronæum attached to the femur with a spring, which maintains their extension without effort on the part of the muscles. The tarsus and metatarsus are represented by a single bone, terminating below in three pullies.

Most commonly there are three toes before, and a thumb behind*; the latter being sometimes deficient. In the Swifts it is directed forwards, [though half-reversible: in the Moth-hunters and some others, inward, at a right angle with the axis of the body]. In the yoke-footed Birds, on the contrary, the external toe and the thumb are disposed backwards [most usually, but sometimes (as in the Touracos and Puff-birds) laterally: in the Trogons, the first and second toes are opposed to the third and fourth; and accordingly the longest toe, or that which corresponds to the middle one in the generality of the class, is *inward*, instead of being *outward*, as in all the other yoke-footed groups]. The number of articulations increases in each toe, commencing with the thumb, which has two, and ending with the external toe, which has five. [The Swifts present a remarkable exception; and it may be remarked that, in the Ostrich alone, only two toes are present.]

In general, [invariably], Birds are covered with feathers, a sort of tegument best

* The word *thumb* is here and subsequently used merely in a popular sense, to signify its antagonism to the other digits; as the hinder thumbs of the *Quadrumana* are represented, in the class of Birds, only by the tarsal spurs of many *Gallinaceæ*.—ED.

adapted to protect them from the rapid variations of temperature to which their movements expose them. The air-cavities which occupy the interior of their body, and [usually] even supersede the marrow in their bones, increase their specific lightness. The sternal portion of the ribs is ossified, as well as the vertebral, to impart more force to the dilatation of the chest. To each rib is attached a small bone, which soon becomes soldered to it, and is directed obliquely backward towards the next rib, all concurring to give additional solidity to the thorax.

The eye of Birds is so conformed as to enable them to distinguish objects both far and near with equal clearness; a vascular and plaited membrane, which extends from the profundity of the globe to the edge of the crystalline, probably assists in displacing that lens. The anterior surface of the globe is also strengthened by a circle of bony pieces; and, besides the two ordinary eyelids, there is always a third, situate at the inner angle, and which, by means of a remarkable muscular apparatus, can be drawn over the front of the eye like a curtain. The cornea is very convex, but the crystalline is flat, and the vitreous humour small.

The ear of Birds has but a single small bone, formed of a branch adherent to the tympanum, and of another terminating in a plate that rests upon the *fenestra ovalis:* their cochlea is a cone slightly curved; but their semicircular canals are large, and lodged in a portion of the skull, where they are surrounded on all sides by air-cavities that communicate with the arca. [Some] nocturnal Birds alone have a large external conch, which however does not project like that of quadrupeds, [though in the restricted genus *Strix* an overlapping cartilaginous flap is developed anteriorly, by which the auditory aperture is closed at will]. The orifice of the ear is generally covered with feathers [the *ear-coverts*], the barbs of which are more fringed than those of other feathers.

The organ of smell, concealed within the base of the beak, has ordinarily three cartilaginous *ossa turbinata*, which vary in complication; it is very sensible, although it has no cavity excavated within the parietes of the cranium. The size of the bony openings of the nostrils determines the strength of the beak; and the cartilages, membranes, feathers, and other teguments which contract these apertures, exert an influence on the perceptibility of odours, and on the sort of nourishment.

The tongue has little muscular substance, and is supported by a bone articulated on the hyoid; in most Birds this organ is not very delicate. [The Parrots probably enjoy most perfectly the sense of taste.]

The feathers, as well as the quills, which differ only in size, are composed of a stem, hollow at its base, and of barbs, which are themselves furnished with smaller ones; their tissue, lustre, strength, and general form, vary infinitely. [They may be conveniently divided into clothing feathers, and those which are subservient to locomotion; the vibrissæ even, which are disposed in some instances as eyelashes, and more frequently impend the nostrils or arm the rictus of Birds, are merely barbless feathers, which are developed and periodically renewed like other feathers. In many groups, the clothing feathers are furnished with a supplementary shaft, or accessory plume, which, in the quills or sustaining feathers, is at most represented by only a few downy filaments. This supplementary plume, in the Emeus, is developed equally with the primary shaft, so that two similar feathers grow from the same quill: and in the Cassowary, there is even a third shaft in addition. In the Poultry and some others,

the accessory plume is large, but of soft and downy texture: others have it reduced to a small tuft of down; while in many it is absent altogether. In some Birds, the vanes of the feathers are to a variable extent united, or soldered into an uniform mass, and there are various additional modifications, too numerous to admit of detail]. The touch must be feeble in all parts that are covered with them; and, as the beak is almost always corneous and but little sensitive, and the toes are invested with scales above and a callous skin underneath, this sense can be of little efficacy in the class of Birds. [In the Snipes and *Lamellirostres*, however, the sense of touch in the bill must be delicate, as testified by their manner of feeding, as well as by the many nervous papillæ distributed over its surface. The enormous bill of the Toucans, also, is very sensitive; and even the hardest bills are traversed by ramifications of the fifth pair of nerves, which terminate in scattered papillæ.]

The feathers are cast twice in the year [in some instances, but by far the greater number of Birds renew their plumage in autumn only; and in no instance are the wing-primaries shed excepting in autumn, or at that moult which corresponds to the autumnal moult. Many, as the Hawks, larger Gulls, &c., retain their entire nestling garb till the second autumn; while others, as the Crows, Starlings, &c., renew every feather previous to the first winter; and there are some groups, as that of the Thrushes, together with various *double-moulting* Birds, as the Pipits and Wagtails, which change their first clothing plumage soon after quitting the nest, but retain their nestling primaries until the second autumn—(that is, until the third renovation of the body feathers). In the Cormorants, Grebes, &c., some additional ornamental plumes are developed towards the commencement of the breeding season; at which time various other Birds undergo a change of colour, unaccompanied by any moult *; while others, again, cast the terminal portion (commonly of a dingy hue) of the greater number of their feathers, which during winter had concealed the brighter tints of summer: two or more of these various modes, by which a seasonal alteration of appearance is effectea, being frequently simultaneously observable in the same individual.] In certain species, the winter plumage differs in its colours from that of summer; and in the greater number, the female differs from the male by colours less vivid, and the young of both sexes then resemble the female. When the adult male and female are of the same colour, the young have a peculiar livery. [As thus expressed, however, these rules require to be qualified by numerous exceptions: the true enunciation of them being, that, when the plumage of the young differs from that of the adult male, or of the female in those few cases where (as in the common Gallinule) this sex is the brighter, that of the other sex may be similar to either of those extremes, or is in various degrees intermediate: the male and female of the common British Redstart, for instance, are dissimilar, and the young do not resemble the adult female; but the garb of the latter is intermediate to those of the adult male and young.†]

* When this takes place, as in certain Gambets (*Totanus*), the colouring matter is often entirely absorbed previously to the autumnal change of feather; and in some double-moulting species, as the Golden Plover, it commonly happens in spring that the colouring secretion tinges the old feathers that are loose, and ready to drop off;—thus proving that a circulation obtains in the pores of feathers, even up to the period of their being naturally cast.—ED.

† There is a *typical* state of plumage in most groups of Birds, which, in certain species, as the Tree Sparrow, is common to old and young of both sexes; but which is very usually obtained only by the adult male, as is observable in the common House Sparrow: in the Robin, Goldfinch, &c., to select other familiar examples, it is acquired by the adults of both sexes; and, in the Common Gallinule, only by the mature female. There are also many Birds in which neither sex assumes this comparatively advanced livery: the larger Bitterns, for example, both sexes of which permanently retain the markings and style of colouring characteristic of only the first or immature dress of the Dwarf-bitterns (subgenus *Ardeola*); the adult male common Bunting (*Emberiza miliaria*), also, thus exhibits corresponding livery to that proper to the females and young of the rest of its group, never advancing, like the males of the other species of Bunting, beyond its primitive nestling colours and markings. We are led to recognize, therefore, two extreme conditions of plumage as regards the colouring,—one generally, but not always, characteristic of mata

The brain, in Birds, offers the same general characters as in the rest of the *Ovipara*; but is distinguished by its very considerable proportionate size, which often even surpasses that of this organ in the Mammalia. It is principally on the tubercles analogous to the *corpora striata* that this volume is dependent, and not upon the hemispheres, which are very small and without convolutions. The *cerebellum* is tolerably large, and almost without lateral lobes, being principally formed by the vermiform process.

The *trachea* of Birds has its rings entire; at its bifurcation is a *glottis*, most usually furnished with peculiar muscles, and named the *lower larynx;* it is there that the voice

rity,—the other of immaturity; the first having usually more decided and contrasted colours; the second being comparatively sombre, with fainter or more blended colours, which however are commonly broken into various streaks or spots, and other different mottlings: where the latter condition, however, becomes permanent, the variegations of the adult bird are in general more distinctly defined; thus a beautiful Himmalayan Thrush (*Turdus Whitei*), which occasionally strays into Europe, retains the mottling of the dorsal plumage peculiar to the unmoulted young of other Thrushes, but the colours of those mottled feathers are much more finely brought out; in like manner the distinct transverse bars on the adult plumage of the Bush-shrikes (*Thamnophilus*) and those on certain Woodpeckers (*Colaptes*), respectively represent the more indistinct markings of the nestling dress of the ordinary Shrikes (*Lanius*) and certain other Woodpeckers (*Chrysoptilus*), which barred plumage is succeeded in the latter by an adult garb devoid of those markings: this increased distinctness is however less apparent in some cases, as in that of the Bittern of North America, the adult markings of which correspond, feather by feather, (their intensity being but inconsiderably enhanced,) with those of the immature Dwarf-bitterns already referred to.

Accordingly, then, it is in the first plumage of Birds that the *affinity* of allied groups is ordinarily most apparent, as is analogously the case with the young of animals in general (the distinctions of all essentially allied groups of which continue to decrease till they disappear successively, as we ascend to the embryo); and the same remark applies, as might be anticipated, to the shape and structure of the feathers, equally with their colouring. Thus, the nestling garb is always much less firm than that subsequently attained; and those feathers which are acuminate in the adult are rounded, or but slightly narrowed, in the young, and in general become gradually more elongated and pointed at each successive moult, till they have acquired their final shape and developement: the dorsal feathers of the common Heron, and clothing plumage of the Starling, may be cited in exemplification. In this respect, also, as with their colouring, the feathers of some species, compared with those of others proximately allied, are specifically arrested at various stages of developement: the adult plumage of the Bitterns represents in this particular the immature garb of the Herons generally; and in the weakness of texture of the dorsal feathers, equally with their mottled markings, the mature livery of the *Ianthocinclæ* corresponds with the nestling dress of the majority of other Birds of the Thrush tribe.

It should be remarked that in some cases where the *typical* plumage is finally attained, this is only after a series of moultings more or less numerous, each successive stage of which may or may not present a nearer approximation to it in different species; it being thus assumed gradually, or abruptly; and, in such cases, it is generally acquired by the male sex sooner than by the female, where both ultimately arrive at it. In the European Oriole, the male alone attains the typical garb, but not before its third or fourth change of plumage, when it is assumed abruptly, or nearly so; in the Dwarf-bitterns, the male acquires its final livery at the first moult, the female not before the third or fourth moult, presenting an intermediate garb in the mean while, which is ultimately exchanged for the same livery as that of its mate. The amount of constitutional vigour tends to determine the period at which the more advanced condition of plumage is obtained, in the ratio of the average period required for its assumption: thus, we perceive little or no irregularity in those instances where the typical dress is gained at the first renewal, but considerable irregularity where the period of its assumption is ordinarily protracted; and it would seem that in the latter case the females are more apt to acquire ultimately the most advanced livery, than in those instances where the male alone regularly obtains it at the first moult; though, as there is always a tendency on the part of vigorous females to throw out the masculine attire, it may be that this apparent difference arises simply from the fact of such females being liable to escape notice, from their consequent similarity to the other sex inducing a belief that they belong to it, and so precluding further examination. Of species thus usually presenting a marked sexual diversity of plumage, we have seen females of the common Redstart, Linnet, Redpole, Red-backed Shrike, and Scaup Pochard, which could not be distinguished externally from males; and all of them contained eggs in the ovarium.

As the assumption of the typical plumage, then, in species wherein it is tardily acquired, is especially dependent on the amount of constitutional vigour, it follows that captive Birds should generally arrive more slowly at their final livery, than those individuals which are unconfined; and it might be predicated, also, that instances of captive females assuming the male plumage, in those species wherein the females ordinarily differ from the males, would be of comparatively unfrequent occurrence. Such are accordingly the facts: but it requires to be noticed, that any effectual injury to the ovarium, or other cause of sterility, also occasions female Birds to throw out the masculine livery (just as the Doe, mentioned at p. 137, with one schirrous ovary, developed an antler on the same side), this fact being very commonly noticed in Pheasants and domestic Poultry. On the other hand, however, it is still more remarkable that a male bird, analogously injured, will sometimes even moult back from the typical plumage to that proper to the female and young; though caponized fowls retain their male costume.

We have thus far treated on the subject only under its most simple phase, as observed in those species which renew their plumage in autumn only; and have entered somewhat into detail, from experience of the great assistance rendered by a knowledge of the characters thus afforded in tracing the affinities of groups, by simple inspection of the plumage: being enabled thus to perceive the systematic relationship of various genera at a glance, which is not obvious in the rest of their external characters, nor even in this one to persons unacquainted with the normal progressive changes characteristic of the particular group. In illustration, let it be supposed that a species of Sparrow existed (which is quite probable), the males of which, like the females of the House Sparrow, retained permanently the colouring of the nestling garb of the latter, (or, in other words, that its plumage presented the same analogy with that of the House Sparrow which the common Bunting's plumage does to that of its congeners): the affinity of such a species to the Tree Sparrow, both sexes of which exhibit at all ages a style of colouring corresponding to that peculiar to the adult male of the House Sparrow, would be rendered intelligible by the mutation incidental to the latter, even though no actual similitude were traceable between the plumage of the Tree Sparrow and that of the imagined species. There are numerous groups, then, the relationship of which may be at once recognized on the principle here indicated.

Among those species which retain their first plumage till the second autumn, its aspect undergoes considerable variation in some, from different causes. Thus, in the Osprey, Gannet, and some others, the upper parts are for a while conspicuously speckled with terminal white spots, on a dark ground-colour; which spots gradually disappearing, as the terminal edges of the feathers are naturally shed, leave the back uniformly dark-coloured and plain. In certain other groups, as in some Harriers (*Circus*), an actual change of colour takes place in the feathers, to a variable extent.

In those species of Birds which undergo a double moult, the sexes are generally similar, or nearly so, in both states of plumage, and always in the winter dress; and even the summer and winter liveries do not in all cases differ, as may be observed in the Tree Pipit (*Anthus arboreus*). Where the contrary prevails in both sexes, the young, in their first down, are subject to possess the colouring of the adult summer garb, as noticeable in the common Guillemot and Razorbill; and, in the plumage which succeeds the down, to resemble the mature winter dress, or to present a combination of the two, which is not uncommon—particularly among the small waders, which subsequently attain their proper winter clothing plumage by a moult towards the close of autumn. When the breeding livery of the male and female differs, the same law prevails as in single-moulting Birds. We have not space to enter more minutely into detail.—ED.

of Birds is formed; the enormous volume of air contained in the air-cavities contributes to the strength of this voice, and the *trachea*, by its various forms and movements, to its intonations. The *upper larynx*, which is extremely simple, has little to do with it.

The face, or upper mandible of Birds, formed principally by the intermaxillaries, is prolonged backwards into two *arcades*, the internal of which is composed by the palatine and pterygoid bones, the external by the maxillaries and jugals, and which are both supported on a moveable tympanic bone, commonly termed the square bone (*os carré*), that represents the *drum* of the ear: above, this same face is articulated or united to the skull by elastic laminæ; a mode of union which always leaves some mobility.

The horny substance which invests the two mandibles supplies the place of teeth, and is occasionally serrated, so as to represent them.* Its form, as also that of the mandibles which support it, varies excessively, according to the sort of food resorted to.

The digestion of Birds is in proportion to the energy of their vitality, and the amount of respiration. The stomach is composed of three parts: the *craw*, which is an expansion of the gullet; the *proventriculus*, a membranous stomach, furnished in the thickness of its coats with a multitude of glands [variously disposed and shaped in different groups], the secretion of which humects the aliment; and lastly, the *gizzard*, armed with two powerful muscles united by two radiating tendons, and internally lined by a coating of cartilage. The food is more readily ground there, as Birds are in the habit of swallowing small stones to augment its triturating power.

In the greater number of species which subsist only on flesh or fish, the muscles and the internal lining of the gizzard are reduced to extreme tenuity, so that it appears to make but one sac with the proventriculus. [The same is noticeable in the Bustards, which subsist mainly upon herbage: a series of intermediate gradations, however, occurring from these to the most powerfully muscular gizzards.]

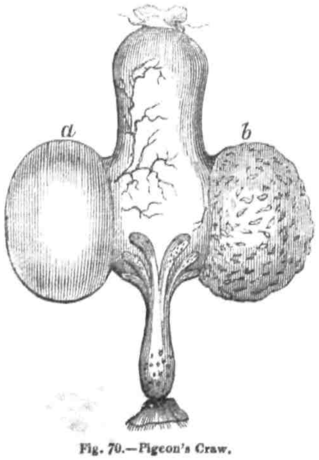

Fig. 70.—Pigeon's Craw.

The dilatation of the craw is also sometimes [even generally] wanting. [This is is commonly situate above the furcula, but in the genus *Palamedea* beyond it: in the Grebes, there is a contraction and intervening space between the proventriculus and gizzard†, which in the very peculiar genus *Opisthocomus* is developed into a considerable cavity (this bird subsisting mainly on green foliage): the *Totipalmati* have generally an accessory pouch to the stomach, analogous to that of the Loricated Reptiles. It may also be mentioned here, that in the Parrots and Pigeons, both exclusively vegetable feeders, the craw is furnished with numerous glands, which become developed in both sexes during the period that they alternately perform the duty

* See note to p.24.—ED.

† The same contraction is noticeable, to a less extent, in the Mergansers, and other piscivorous Birds with strong and muscular gizzards: hence the fishes that they swallow are mechanically prevented from entering the gizzard till they have been sufficiently reduced, by the action of the gastric juice elaborated in the proventriculus, to pass its aperture.

of incubation, and the function of which is to secrete a lacteal substance, with which the young are at first nourished. The craw of Birds generally is situate on the right side only; but in the Pigeons it is double, and fig. 70 represents the ordinary aspect of that on one side when inflated (*a*), and the thickened glandular appearance of that on the other (*b*), as noticeable in Pigeons that have newly-hatched young. In other Birds, the craw merely serves as a reservoir for such food as cannot be immediately taken into the stomach; though grain is generally moistened there and softened, by macerating in fluid sipped for the purpose].

The liver voids its bile into the intestine by two ducts, which alternate with the two or three by which the pancreatic fluid passes. The pancreas of Birds is large, but their spleen is small; they have no epiploon, the functions of which are in part fulfilled by the partitions of the air-cavities. The cœcal appendages [when present] are placed near the origin of the rectum, and at a short distance from its outlet; these are more or less long, according to the regimen of the bird.* The Herons [as also the Smew Merganser] have only one, which is minute; in other genera, as that of the Woodpeckers, they are wanting altogether.

The *cloaca* is a pouch in which the rectum, the ureters, and the spermatic ducts—or, in the female, the oviduct—terminate; it opens externally by the anus. As a general rule, Birds do not urinate; the secretion of the kidneys being mingled with their solid excrement. The Ostriches alone have the cloaca sufficiently dilated to allow of an accumulation of the urine. [In the majority of Water-fowl, there is a small accessory pouch to the cloaca, termed the *bursa Fabricii:* its use has not been clearly ascertained.]

In most of the genera, coition is effected by the simple juxta-position of the anus; the Ostriches and many aquatic Birds [those which copulate in water], however, have a penis furrowed with a groove, along which the seminal fluid is conducted. The testicles are situate internally above the kidneys, and near the lungs; [they attain an enormous developement towards the season of propagation;] only one oviduct is developed, the other [with its ovary] being reduced to minute size.

The egg, detached from the ovary, where only the yolk is perceptible, imbibes in the upper part of the oviduct that exterior fluid termed the white, and becomes invested with its shell in the lower part of the same canal. The chick is developed by incubation, unless where the heat of the climate suffices, as in the case of the Ostrich [in some localities]. The young bird has on the tip of its beak a horny point, which serves to rupture the shell, and falls off a few days after exclusion.

Every one knows the varied industry which Birds exhibit in the construction of their nests, and the tender care which they take of their eggs and young; it is the principal part of their instinct. With regard to the rest, their rapid passage through different regions of the air, and the intense and continued action of that element upon them, renders them presensible of the variations of the atmosphere, to an extent of

* Some difficulties occur in the way of this explanation, unless duly qualified in reference to the normal characters of particular groups, or subtypes of form. Thus, the Hawks and the Owls subsist pretty nearly on the same regimen; the cœca being in the former instance constantly minute, and in the latter as invariably of considerable size, but with the same proportional dimensions in every species: nor can this diversity be explained on another principle that has been advanced, equally correct in its application to groups; viz., that the somnolent inactive Owls require to have more complex digestive organs (which should retain the chyme longer in its passage), than the more energetic tribe of Falcons; inasmuch as the rapidly-flying, active Harfang, or Snowy Owl, which on the wing can scarcely be distinguished from the Jer Falcon, possesses cœca—as before generally intimated—proportionally quite as large as those of the light-flapping Barn Owl; while the lazy, smooth-sailing Buzzard, the floating Kite, and the buoyantly-skimming Harrier, present no further developement of these appendages than the darting Hawks, or the impetuous, far-rushing Falcons. A variety of analogous instances might be enumerated.—ED.

which we can have no idea, and from the most ancient times has caused to be attributed to them, by superstitious persons, a power of announcing future events. It is doubtless upon this faculty that the instinct depends which [periodically] agitates migratory Birds, and impels them to direct their course towards the equator when winter approaches, and pole-ward at the return of spring.* They are not devoid of memory, and even imagination—for they dream; and every body knows with what facility they may be tamed, taught [in numerous instances] to perform various services and to retain airs and words.

DIVISION OF THE CLASS OF BIRDS INTO ORDERS.

Of all classes of animals, that of Birds is the most strongly characterized, that in which the species bear the greatest mutual resemblance, and which is separated from all others by the widest interval.

Their systematic arrangement is based, as in the *Mammalia*, on the organs of manducation or the beak, and on those of prehension, which are again the beak, and more particularly the feet. [The configuration of the sternal apparatus, also, (which we have illustrated by numerous figures,) and the modifications of the digestive and sometimes vocal organs, supply highly important characters on which to ground the subdivisions.]

One is first struck by the character of *webbed* feet, or those wherein the toes are connected by membranes, that distinguish all *swimming* Birds.† The backward position of their feet, the elongation of the sternum, the neck, often longer than the legs, to enable them to reach below them, the close, shining plumage, impervious to water,—altogether concur with the feet to make good navigators of the *Palmipedes*.

In other Birds, which have also most frequently some small web to their feet, at least between the two external toes, we observe elevated tarsi; legs denuded of feathers above the heel-joint; a slender shape; in fine, all the requisites for fording along shallow water, in search of nourishment. Such, in fact, is the regimen of the greater number; and, although some of them resort exclusively to dry places, they are nevertheless termed *Shore-birds* or *Waders*.

Amongst the true land-birds, the *Gallinaceæ* have—like our domestic Cock—a heavy carriage, a short flight, the beak moderate, its upper mandible vaulted, the nostrils partly covered by a soft and tumid scale, and almost always the edges of the toes indented, with short membranes between the bases of those in front. They subsist chiefly on grain.

Birds of prey have a crooked beak, with its point sharp and curving downward; and the nostrils pierced in a membrane that invests its base: their feet [save in the Vulture group] are armed with stout talons. They live on flesh, and [the Vultures

* It is certain, however, that the rapid enlargement of the sexual organs is the immediate stimulant to migration in the spring; while decline of temperature, most generally, is the directly predisposing agent in the autumn: this is manifest in the case of migratory Birds kept in confinement. The instances of the Swift, and *adult* Cuckoo, retiring southward at the hottest season of the year, are more difficult of explanation, and indicate some ulterior agency not hitherto divined; though they do not affect the multitudinous observations, which conclusively prove the influence of decline of temperature. It is less easy to imagine physical agency that should constantly impel migratory animals to travel in the right direction; and the marvel increases when we consider the length of route ordinarily traversed, and still more the extraordinary fact (familiar to all practical observers) of Birds of passage, unless when driven by stress of weather, returning, both in summer and winter, to their former place of abode, and this even when reared in confinement, and released immediately previous to their first journey.—ED. (See note to p. 31.)

† It is most difficult thus to generalize in the class of Birds. For instance, the Gallinules, or *Moorhens*,—habitual swimmers,—have no connecting membrane to the toes; while the Terns, which are never seen to swim, have their toes completely webbed, &c. Even the Herons, the Curlews, and numerous other *waders*, will sometimes take the water of their own accord, and swim across pools, though their structure does not indicate such a habit.—ED.

again excepted] pursue other Birds; their flight accordingly is mostly powerful. The greater number still retain a slight web betwixt their external toes.

The *Passerine Birds* comprise many more species than all the other families; but their organization presents so many analogies that they cannot be separated, although they vary very much in size and strength. Their two external toes are joined at the base, and sometimes higher.

Finally, the name of *Climbers* is applied to those Birds in which the external toe is directed backwards like the thumb, because the greater number of them [some of them] avail themselves of a conformation so favourable for a vertical position, to climb along the trunks of trees.* [As constituted upon this single character, the present group is a most unnatural one, excluding genera that in every other respect belong to it, and including the Parrots, which differ widely from the rest in every other detail of their conformation. Besides the Parrots, also, which are the only true *climbers* among Birds, (if we except perhaps the Colies,) the Woodpecker and Barbet groups comprise all the yoke-footed species which ascend the trunks of trees, the latter only being enabled to descend them; and corresponding genera to these occur among the *Passerine* Birds, as the Creepers and their allies—to the Woodpeckers, and the Nuthatches—to the Barbets. The Trogons moreover, as stated at p. 156, are yoke-footed on a different principle from the rest. We have no hesitation in placing the Parrots at the head of the whole series of the class of Birds.]

Each of these orders subdivides into families and genera, principally after the conformation of the beak. But these different groups pass into each other by almost imperceptible gradations, insomuch that there is no other class in which the genera and subgenera are so difficult of limitation.

THE FIRST ORDER OF BIRDS,—

THE BIRDS OF PREY (*ACCIPITRES*, Lin.)—

Are recognized by their hooked beak and talons,—powerful weapons, with which they immolate other Birds, and even the weaker Quadrupeds and Reptiles. They are among Birds what the *Carnivora* are among Quadrupeds.† The muscles of their thighs and legs indicate the force of their claws; their tarsi are rarely elongated: they having all four toes; and the claw of the thumb and that of the innermost toe are the strongest.

They constitute two families, the Diurnal and the Nocturnal.

The DIURNAL BIRDS OF PREY have the eyes directed sideways; a membrane, termed the *cere* [as in the Parrots], covering the base of the beak, in which the nostrils are pierced; three toes before [the outer in the Osprey genus reversible], and one behind, unfeathered, the two exterior almost always connected at base by a short membrane; the plumage close, the quills strong, and flight powerful. [They have constantly a large craw (fig. 71) or dilatation of the gullet]; their stomach is almost wholly membranous; their intestines [save in the Osprey genus] but little extended, and furnished with minute cœca. The sternum (fig. 72) is large and completely ossified, [or with only a posterior foramen left, in most of the genera], in order to give more extended attachment to the muscles of the wing; and their fourchette

* In my first *Elementary Sketch*, in 1798, I was obliged to suppress the order *Picæ* of Linnæus, which has no one determinate character, [at least as constituted by that naturalist]. M. Illiger, and the majority of recent Ornithologists, have assented to this suppression.

† As the frugivorous Parrots may be compared to the *Quadrumana* —ED

(fig. 72, *a*) is semicircular and very wide, the better to resist the violent pressure of the humerus incidental to a rapid flight. [The young undergo no change of feather until their second autumn; and they renew their plumage slowly, and in no instance more than once in the year; its seasonal change being confined to a slight wearing off, rather than a natural shedding, of the margins of the feathers: in several species, however, the colour indicative of maturity is partially acquired, previously to moulting, by a change of hue in the first or nestling plumage. The eggs of Accipitrine Birds are nearly spherical; and those of the present division are generally more or less spotted or blotched with rusty-brown. The young are at first densely clad in short soft down.]

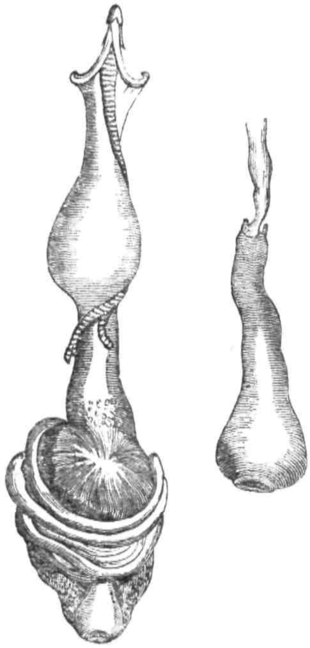

Fig. 71.—Alimentary Canal of the Common Buzzard: exhibiting the first expansion, or *craw*; and (below the divarication of the *trachea*) the proventriculus, stomach, and intestines. The second figure represents the termination of the small intestines, with the rectum swelling below to form the cloaca, and two minute cœca placed at the junction of the great and small intestines.*

Linnæus made only two genera, which are two natural divisions,—the VULTURES and the FALCONS.

THE VULTURES (*Vultur*, Lin.)—

Have the eyes even with the head; the tarsi reticulated, or, in other words, covered with small scales; the beak lengthened, curved only at the end; and a greater or less portion of the head, and generally of the neck, [in the adult,] devoid of feathers. The force of their talons does not correspond with their stature, and they make more use of their beak than of their claws. Their wings are so long, that in walking they hold them half-extended. They are of a cowardly disposition, and feed on carrion oftener than on living prey: when they have gorged themselves, their craw forms a large protuberance above the fourchette, a fetid humour issues from their nostrils, and they are almost reduced to a state of apathy. [They differ, moreover, from all the succeeding groups, till we arrive at the Poultry,—with the sole exception of the Secretary genus (*Gypogeranus*), which indeed might be ranged with them,—in possessing more than twelve cervical vertebræ †: their fourchette, though extremely stout and wide, is flattened as in the Owls: the sternal crest low, and reduced anteriorly; and the posterior edge of the sternum (fig. 73), in some of those of America, is doubly emarginated for some time: they even further accord with the Owls in having a rib less than the Falconine genera.

THE VULTURES, properly so called, (*Vultur*, Cuv.)—

Have a large and strong beak, the nostrils opening cross-wise at its base, the head and neck without feathers or caruncles, and a collar of long feathers, or of down, at the base of the neck. They have hitherto been found only on the old continent [but none of the tribe are met with in Australia, where the absence of larger indigenous quadrupeds than the Kangaroos, and of predatory animals that should leave the surplus of their meals to putrefy, indicate that they could not be supported.] ‡

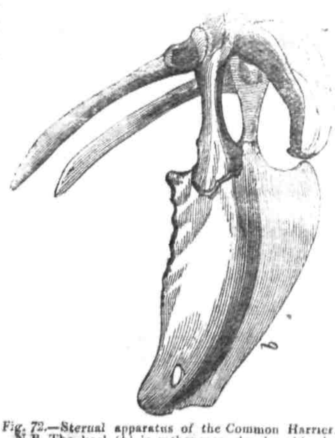

Fig. 72.—Sternal apparatus of the Common Harrier. N.B. The keel (*b*) is rather more developed in the Falcons; less so in the Eagles.

* Copied from M'Gillivray's *Rapacious Birds of Britain*.—ED.

† In the long series of groups adverted to, the thirteenth vertebra generally, but not always, bears a pair of minute ribs, which diminish till they disappear in some species; if, therefore, the thirteenth vertebra is to be considered as *cervical* in such cases, as not bearing a rib, the difference is essentially trifling, and does not intrinsically affect the above generalization.—ED.

‡ The *Alectura*, Gray, which has been ignorantly classified with the Vultures, is in every respect a true Poultry bird.

exceedingly docile Birds, and are those which are most generally employed in *falconry*, being taught to pursue game, and to return when called.

The Peregrine Falcon (*F. communis*, Gm.; [*F. peregrinus*, Lin.).—Apparently a cluster of indefinitely distinguishable species, generally diffused in temperate climates, both northward and southward of the equator]. The species mostly trained for purposes of falconry.

[There are numerous others, of which the Jer Falcon, the Lanner,—which is intermediate to the Jer and Peregrine Falcons,—the Hobby, the Red-legged, and the Merlin Falcons, inhabit northern Europe. The Red-legged Falcon is remarkable for sometimes breeding in society. *F. concolor* and some others have the tarsi elongated: and in *F. æsalon* (the Merlin), and some allied species, the third quill-feather equals and sometimes exceeds the second; these last are also somewhat Hawk-like in the structure of their feet, and in their manners. The division of Kestrel-falcons (termed *Cerchneis* by Boié) comprehends Birds of weaker structure, which have the sternum proportionally smaller; in some the front of the tarsi is scutellated, as in the short-winged Hawks: the Kestrel-Falcons prey chiefly on field-mice, which they discern as they hover stationary at a moderate altitude, with the head invariably turned towards the wind; it is thus that they have obtained the names of *Wind-hover* and of *Stand-gall* or "stand-gale:" there are several species, two only of which inhabit Europe—the common Kestrel (*F. tinnunculus*, Lin.), and the White-clawed Kestrel (*F. cenchris*, Frisch. and Naum; *F. tinnunculoides*, Tem.).

The division *Hierofalco*, Cuv., was instituted by mistake, for the reception of the Jer Falcon, under the supposition that its beak had only a festoon, as in the short-winged Hawks; the tooth of these Birds being sometimes cut away by the falconers. *Gampsonyx*, Vigors, however, fulfils nearly the conditions which were assigned to *Hierofalco;* the upper mandible being devoid even of emargination, and considerably resembling that of the Buzzards: the head is small, feet and tarsi robust, the latter feathered half-way from the joint; wings the same as in *Falco:* one species only is known, a bird of small size from Brazil (*G. Swainsonii*, Vig.).

Other species (the *Ierax*, Vigors), of very small size, have the second and third quill-feathers nearly equal; the upper mandible strongly and sharply bidentated, by the further developement of a sinuation visible in the rest. Two species are known, from Java and Manilla respectively, (*F. cærulescens*, Edwards, and *I. erythrogenys*, Vig.)—They are scarcely larger than a Swallow, but yield to none in energy and spirit: their wings, however, are less firm than in other Falcons.

There are some bidentate species, which in other respects accord more nearly with the Goshawks: they are

THE HARPAGONS (*Harpagus*, Vig.; *Bidens*, Spix),—

Which present an acute bidentation of both mandibles, and have hitherto been found only in South America.

The best known species (*F. bidentatus*, Latham) is figured in the adult state by Spix as *Bidens rufiventer*, and in immature plumage as *B. albiventer*.

Others more nearly approximate the Perns, as

THE FALCOPERNS (*Lepidogenys*, Gould),—

The wings of which are remarkably long, having the third quill longest; feet very short, and the talons small and but slightly curved: the bidentation is less strongly marked than in the preceding.

F. lophotes, Tem., an elegantly-crested bird from India, and another from Australia—*L. subcristatus*, Gould, pertain to this division. Nearly allied would seem to be the *Aviceda*, Swains., from Western Africa; except that its armature is considerably more powerful.] The *Baza* of Hodgson is probably identical with *Lepidogenys*.

The second section of the great genus *Falco* is that of the Birds of prey termed *Ignoble*, because they cannot be so well employed in falconry; a tribe much more numerous than that of the *Nobles*, and which it is necessary to subdivide considerably. Their longest quill-feather is almost always the fourth, the first being very short, which has the same effect as if the tip of the wing had been obliquely cut off; hence, *cæteris paribus*, result diminished powers of flight. Their beak, also, is not so well armed, as there is no lateral tooth near its point, but only a slight festoon about the middle of its length.

THE EAGLES (*Aquila*, Brisson),—

Which form the first tribe, have a very strong beak, straight at its base, and curved only towards the point. Among them we find the largest species of the genus, and the most powerful of all the Birds of prey.

THE EAGLES, properly so called (*Aquila*, Cuv.)—

Have the tarsi feathered down to the base of the toes: they inhabit mountains, and pursue Birds and Quadrupeds; their wings are as long as the tail, their flight both elevated and rapid, and their courage superior to that of most other Birds.

[The Golden Eagle (*F. chrysäetos*, Lin.), the Grecian Eagle (*A. Heliaca*, Savigny; *F. imperialis*, Tem.), the Spotted Eagle (*F. nævius* and *maculatus*, Gm.), the Social Eagle (*A. Bonelli*, Bonap.), and the Little Eagle (*F. pennatus*, Gm.), are the European species, which successively decrease in size in the order announced; the last-named being smaller than a Common Buzzard.]

Fig. 75.—White-headed Erne.

New Holland produces Eagles of similar form to those of Europe, the tail excepted, which is cuneiform. Such is the Wedge-tailed Eagle (*A. fucosa*, Cuv.).

[There are many others.] We should remark that the transition from the Eagles to the Buzzards is effected by insensible gradations, [the typical Buzzards being merely small-sized Eagles, with weaker armature].

THE ERNES (*Haliæetus*, Cuv.)

Have wings resembling those of the preceding, but the tarsi clothed only on its upper half with feathers, the remainder being semi-scutellated. [Their beak also is longer and larger.] They frequent the shores of rivers and of the sea, and subsist in great part upon fish [without disdaining carrion, like the true Eagles.

The Cinereous Erne (*F. albicilla*, Lin.) of Europe, and the American White-headed Erne (*F. leucocephalus*, Lin. fig. 75) are characteristic examples. There are also some of small size, as the bird commonly termed the Pondicherry Kite (*F. ponticerianus*, Gm.), which the Hindoos consider sacred to Vishnu. The *Cunduma* of Hodgson is merely a large *Haliæetus*].

THE OSPREYS (*Pandion*, Savigny)—

Have [somewhat] the beak and feet of the Ernes; but their talons are round underneath, while in other Birds of prey [save in the true *Elani*] they are grooved or channelled; their tarsi are reticulated, and the second [third] quill of their wings is longest. Their sternum (fig. 76) differs from that of other Falcons (see fig. 72) in becoming narrower towards its posterior margin, where a notch exists analogous to the *inner* emargination of the Gallinazos, but not to the foramen observable in the Falcons generally: the intestine is very slender and of great length (whereas in the Ernes it does not differ from that of other Falcons): the superorbital bone does not project: the feathers even are completely destitute of the supplementary plume, (which in the Ernes and most other Falcons is considerably developed), and are not lengthened over the tibia: the outer toe is reversible, and the foot astonishingly rough underneath, to enable them to hold their slippery fishy prey, on which they subsist exclusively. This is by far the most strongly characterized division of the Linnæan genus *Falco*.*]

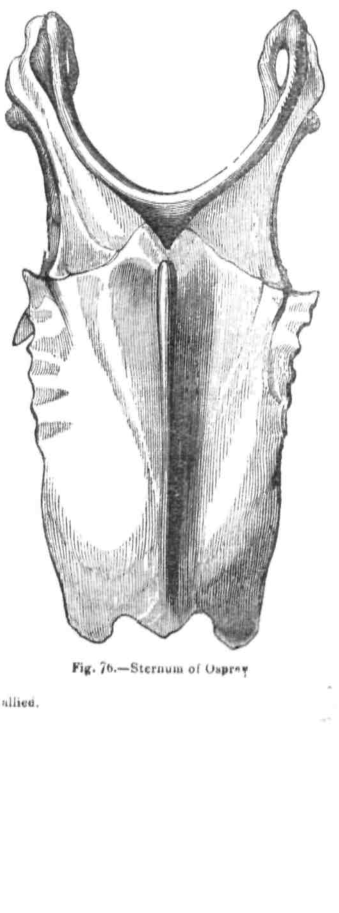

Fig. 76.—Sternum of Osprey

The Common Osprey (*F. haliæetus*, Lin.)—[Evidently a cluster of a allied species, very generally distributed. That of New Holland (*P. leucocephalus*, Gould) has the crown white. In some places this bird nidificates in large societies.

As a group, externally intermediate to the Ernes and Ospreys, might be separated the *F. ichthyætus*, Horsf., and several allied species from Australasia. They are essentially Osprey-like Ernes, which most probably retain the anatomy of the latter, and exhibit greater develoDement of the mandibular tooth than either.]

* The genus *Herpetotheres* alone is nearly allied.

THE MARSH-EAGLES (*Circäetus*, Vieillot)—

Hold a sort of mediate station between the Ernes, the Ospreys, and the Buzzards. They have the wings of the Eagles and Buzzards, and the reticulated tarsi of the Ospreys. Such are

The European Marsh-eagle, or *Jean-le-blanc*, (*F. gallicus*, Gm.),—the beak of which curves more rapidly than in other Eagles, and the toes are proportionally shorter. It exceeds the Osprey in size, and inhabits Europe, preying chiefly on reptiles.

Le Bateleur of Le Vaillant, (*F. ecaudatus*, Shaw).—An African species, remarkable for the extreme shortness of its tail, and its beautifully variegated plumage. [It constitutes the division *Helotarsus* of Smith, synonymous with *Terathopias* of Lesson, differing in several particulars from the others, and particularly in the baldness of its cheeks. The Bateleur preys on young Gazelles, young Ostriches, &c., and also on putrid carrion, disgorging the latter into the throats of its young, as observed of the Vultures.]

America produces Eagles with long wings like the foregoing, and naked scutellated tarsi, in which a more or less considerable proportion of the sides of the head, and sometimes of the throat, is denuded of feathers. The general name of

CARACARAS—

Has been applied to them. From this group M. Vieillot has made his genera *Daptrius*, *Ibycter*, and *Polyborus*, [partly] according to the greater or less extent of the bare part of the head. [*Phalcobanus*, d'Orbigny, *Gymnops* and *Milvago*, Spix, have also been applied to divisions of the Caracaras. These Birds are carrion-feeders, and pass their time chiefly on the ground, amongst the herbage, where their gait is ambulatory. All are from the warm regions of America.]

THE CORONARDS, or short-winged Fisher-eagles, (*Harpyia**, Cuv.; [*Thrasäetos*, G. Gray])—

Are also American Eagles, which have the tarsi very thick and strong, reticulated, and half-covered with feathers, as in the Ernes, from which they differ chiefly in the shortness of their wings; their beak and talons are stronger than in any other tribe.

The Harpy Coronard or Eagle (*F. harpyia*, and *F. cristatus*, Lin.).—Of all Birds, this possesses the most terrific beak and talons; it is superior in size to the common Eagle. On the back of its head are elongated feathers, forming a sort of fan-like crest upon the nape, which, when erected, impart to its physiognomy a resemblance to the tufted Owls: like them, also, its external toe is frequently directed backward. It is said to be so strong, as to have sometimes cleft a Man's skull with a blow of its beak. The Sloths are its ordinary food, and it not unfrequently carries off Fawns.

THE EAGLE-HAWKS (*Morphnus*, Cuv.)—

Have, like the preceding, wings shorter than the tail; but their elevated and slender tarsi, and their feeble toes, oblige us to distinguish them. Some have the tarsi naked and scutellated.

The Crested Eagle-hawk of Guiana (*F. guianensis*, Daud.), resembles singularly, in its colours and markings, the Harpy Coronard of the same country; but is not so large, and its naked and scutellated tarsi sufficiently distinguish it.

F. urubitinga, Lin., is crestless. This handsome species hunts in inundated grounds. [Certain other uncrested species, with very long tarsi, constitute the *Limnäetos*, Vigors.

Others have elevated tarsi, feathered throughout their length [the *Spizäetus* of Vieillot].

The Tufted Black Eagle-hawk of Africa (*F. occipitalis*, Daud.),—inhabits the whole of that continent.

The Variegated Eagle-hawk (*F. ornatus*, Daud.; *F. superbus* and *coronatus*, Shaw: *Harpyia braccata*, Spix, refers to the young).—A handsome species from South America, which varies from black and white to deep brown. [Certain Indian species compose the *Nisaëtos* of Hodgson.]

Finally, there are in America some Birds with beaks as in all the preceding; very short, reticulated tarsi, half-feathered in front; wings shorter than the tail; but the most distinctive character of which consists in their nostrils, which are almost closed, and resemble a fissure. A small tribe may be made of them, designated

THE CYMINDUES (*Cymindis*, Cuv.).

Such is

The small Cayenne Hawk of Buffon (*F. cayennensis*, Gm.); which has another peculiar character, by possessing a small tooth at the bend of its beak.

[*F. hamatus*, Illiger, ranged by the author in *Cymindis*, composes the *Rostrhamus* of Lesson: its beak is very narrow, the upper mandible resembling a long and slender claw: tail slightly furcate.

* This term was previously applied to a subgenus of *Cheiroptera*.—ED.

THE ASTURINES (*Asturina*, Vieillot)—

Have been generally placed next. They have the nostrils lunulated; the bill straight at its base; wings short, and the tarsi also short and somewhat slender.

A. cinerea, Vieillot, a species from Guiana, may be cited in exemplification.]

THE HAWKS (*Astur*, Bechstein; *Dædalion*, Savigny),—

Which form the second division of the *Ignobles*, have wings shorter than the tail, as in the last three tribes of Eagles; but their beak curves from its base, as in all that follow.

THE GOSHAWKS (*Astur*, as restricted)—

Have the tarsi [more distinctly] scutellated, and comparatively short.

The European Goshawk (*F. palumbarius*, Lin.), equals the Jer Falcon in size, but always stoops obliquely on its quarry. Falconers, however, sometimes use it for the weaker kinds of game. It is common in the hilly and secondary mountain ranges of Europe.

Among foreign Goshawks, we may notice that of New Holland (*F. Novæ Hollandiæ*, White), which is often entirely snow-white; but it appears that these white individuals constitute a variety only of a bird of the same country, pale ash-coloured above, white below, with vestiges of pale undulations.

We may approximate to the Goshawk certain American Birds, with short wings and tarsi, the latter reticulated. [These are

THE NICAGUAS (*Herpethotheres*, Vieillot; *Dædalion*, Vigors),—

A strongly characterized division, interesting, as presenting evidently a modification of the peculiar Osprey type, to which genus they alone appear to be allied. It is particularly desirable, therefore, that their anatomy should be ascertained.]

The Nicagua of Azara, or *Laughing Falcon*, (*F. cachinnans*, Lin.): so named from its cry. From the marshes of South America, where it preys on reptiles and fish. [Its colouring, and the texture of its plumage, are the same as in the Osprey; and it has similar short feathers on the tibia. *F. melanops*, Lath, and *F. sufflator*, Lin., appertain to this division; the latter, however, constituting the restricted *Physeta* of Vieillot.]

THE SPARROW-HAWKS (*Nisus*, Cuv.; [*Accipiter*, Ray])—

Have longer and more slender tarsi than the Goshawks, [still shorter wings, and the middle toe much lengthened]; but the passage from one to the other of these divisions is almost insensible.

Our common Sparrow-hawk (*F. nisus*, Lin.) has the same colouring as the Goshawk, but is much less in size; notwithstanding which it is employed in falconry. There are foreign species still smaller; but also some that are much larger, as

The Chaunting Hawk (*F. musicus*, Daud.),—a native of Africa, where it pursues Partridges and Hares, and builds in trees. It is the only bird of prey known that sings agreeably, [by which, however, cannot be meant that it inflects the voice, as in those Passerine Birds which have additional laryngeal muscles. This bird,—and there is more than one species here confounded,—has a much weaker bill, and longer wings, than the true Sparrow-hawks; it has probably been made the type of a separate division.

The *Gymnogenys* of Vieillot may also be introduced here. It is a Hawk with very long wings, lengthened and distinctly scutellated tarsi, and short toes, but the most distinctive character of which consists in its being naked above the bill and on the cheeks. The only species, *G. madagascariensis*, is grey, with round black spots on the wings, and the lower parts below the breast transversely rayed: it bears some resemblance to the Secretary.

The species of Hawks displays the maximum sexual disparity of size, in favour of the female.]

THE KITES (*Milvus*, Bechst.)—

Have short tarsi, and feeble toes and claws, which, added to a beak equally disproportioned to their size, render them the most cowardly of the whole group: they are further distinguished by their excessively long wings, and by their forked tail, in consequence of which their flight is very swift and easy.

Some have the tarsi very short, reticulated, and half-feathered above, like the last small tribe of Eagles: [their claws, save that on the middle toe, are rounded underneath]. Such are

THE ELANETS (*Elanus*, Savigny).

The Black-winged Elanet (*F. melanopterus*, Daud.); a common species from Egypt to the Cape, and which appears to be found in India, and even in America. [The American and New Holland species are distinct.] Insects are almost its sole prey.

The Swallow-tailed Glede (*F. furcatus*, Lin.).—Larger than the preceding, [with wings excessively long, and tail

deeply furcate]. It attacks reptiles [and the larger insects, and has been known to scrape out Wasps'-nests like the Pern. Its talons are not rounded underneath, on account of which, together with other distinctive characters, it is now generally recognized as constituting the *Nauclerus*, Vigors. This bird is indigenous to America, but has been known to stray into Britain. It is social in its habits, and almost gregarious. A nearly allied African species constitutes the *Elanoides* of Vieillot.]

THE KITES, properly so called (*Milvus*, Cuv.)—

Have the tarsi scutellated and stronger, [and are very nearly related to the Ernes].

The Common or Red Kite (*F. milvus*, Lin.).—Of all European Birds, this remains longest and most tranquilly on the wing. It scarcely attacks any thing but reptiles. [Another European species, not hitherto found in Britain where the first is fast disappearing, is

The Black Kite (*M. ater*, Gm.).—The author has likewise ranged here

The American Puttock (*F. plumbeus*, Lath.), or the *Mississipi Kite* of Wilson, which is referrible to Vieillot's genus *Ictinia*, now generally accepted. This forms an obviously distinct group, the members of which are much more powerfully armed than the Kites, having a short and stout beak, the upper mandible of which is somewhat angularly festooned, and talons comparatively developed. They prey, however, principally on the larger insects, and occasionally on Snakes and Lizards: are most nearly related to the Elanets.]

THE PERNS (*Pernis*, Cuv.),—

Or *Honey Buzzards*, combine, with the weak bill of the Kites, a very peculiar character, in having the space between the eye and beak, which in the rest of the genus *Falco* is naked, and only furnished with some [radiating] bristly feathers, covered with close feathers disposed like scales; their tarsi are half-feathered above, and reticulated; their tail even; wings long, [the third quill being longest]; and their beak curved from its base, as in all that follow.

The Common Pern (*F. apivorus*, Lin.) pursues insects, and principally Bees and Wasps, [the combs of which it scratches out of banks to feed on the maggots: in default of these, however, it will attack small warm-blooded animals and reptiles. It runs with celerity on the ground; is migratory; and generally builds on the tops of lofty beeches. Two or three additional species have been ascertained, all from the Eastern Continent].

THE BUZZARDS (*Buteo*, Bechstein)—

Have long wings, the tail even, the beak curved from its base, the interval between it and the eyes without feathers, [at least such as the Perns exhibit], and the feet strong.

Some of them have the tarsi feathered to the toes [the *Butäetes*, Lesson]. They are distinguished from the Eagles by having the beak curved from its base, and from the Hawks and Eagle-hawks by their feathered tarsi and long wings. Europe possesses one,

The Rough-legged Buzzard (*F. lagopus*, Lin.), [of which *F. Sancti Johannis*, Auct., appears to be merely the old individuals.*]—One of the most widely diffused of Birds, being found almost everywhere. [It frequents marshy tracts, and particularly rabbit-warrens, which it beats till very late in the evening.]

But the greater number of Buzzards have the tarsi naked [except on the upper half in front] and scutellated. In Europe there is but one,

The Common Buzzard (*F. buteo*, Lin.).—The commonest and most noxious bird of prey throughout Europe. It remains all the year in the forests, descends upon its prey from the top of a tree, and destroys much game.

Some species are crested, [have also naked cheeks, and reticulated tarsi. They are barely separable from the *Circäeti*.

THE HÆMATORNS (*Hæmatornis*, Gould)].

F. bacha, Auct.—A very savage bird of Africa, which preys chiefly on the *Hyraces*. [Other naked-cheeked Buzzards compose the *Buteogallus*, Lesson.]

THE HARRIERS (*Circus*, Bechst.)—

Differ from the Buzzards in their more elevated [and very slender] tarsi, and by a sort of collar, which the tips of the feathers which cover the ear form on each side of the neck. [These Birds frequent open moorlands, over which they skim in search of prey very close to the ground, and nestle and always roost on its surface.†]

* We have seen a British-killed specimen as dark as any from America.—ED.

† Some systematists consider the Harriers to form a link from the Falcons generally to the Owls; but neither in the skeleton, as shown by the sternal apparatus (fig. 72), nor in their digestive organs, do they approximate the latter in the least degree. The structure of the ear, resembling that of other Falcons, is shown at fig. 77. They are most nearly related to the Hawks.

There are only three species in France, which have been multiplied by the nomenclators on account of the variations of their plumage. [The Common, Montagu, and Marsh Harriers are alluded to; besides which the *C. pallidus*, an abundant Asiatic species, has recently been met with in the east of Europe. There are numerous others.]

Fig. 77.—Ear of Harrier.

Finally,

THE SECRETARY (*Gypogeranus*, Illig.),—

Is an African bird of prey, the tarsi of which are at least double the length of those of the preceding, which has induced some naturalists to range it among the Waders; but its thighs, entirely covered with feathers, its hooked beak, projecting eyelids, and all the details of its anatomy, concur to place it in the present order. Its tarsi are scutellated, the toes proportionally short, and the circumference of the eyes naked; it has a long rigid crest on the occiput, and the two middle feathers of its tail extend far beyond the others. An inhabitant of the arid and covertless plains in the neighbourhood of the Cape, it pursues reptiles on foot, whence its claws become much worn. Its principal strength is in the foot. It is the

Falco serpentarius, Gm.—An attempt has been made to multiply the breed in Martinique, where it might render the most important service by destroying the lance-headed Vipers which infest that island. [This bird, two if not three species of which are recognized, resembles the Vultures in having fifteen cervical vertebræ. It offers no molestation to poultry or other warm-blooded animals.]

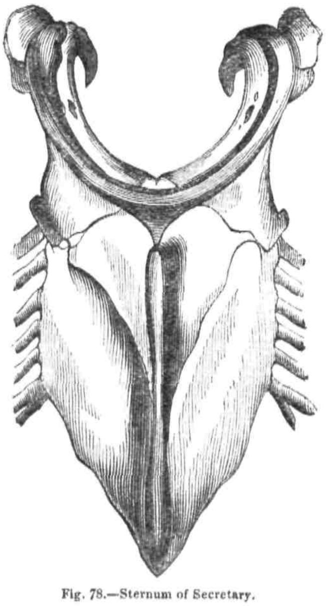

Fig. 78.—Sternum of Secretary.

Although a vast number of generic and subgeneric names have been applied, the DIURNAL BIRDS OF PREY may be reduced to comparatively few natural divisions. After detaching the Vultures and the Secretary, the genera *Pandion* and *Herpethotheres* may be signalized as forming a particular subdivision apart from all the rest. The whole of the remainder then form an equivalent natural group, the members of which scarcely differ anatomically. The most distinct subdivision is that of the Coronards, which alone differ in the number of pelvic vertebræ, and in having the outer toe reversible, as in the Ospreys and Owls. The rest are little else than adaptive modifications of one another, according in all their rudimental characters. We may commence with the Falcon group, followed by that of the Hawks (or the subdivisions *Dædalion*, *Asturina*, *Astur*, *Accipiter*, and *Gymnogenys*); the Harriers naturally succeed, which lead by *C. æruginosus* to the Ernes, and then to the Kites (*Milvus*, as restricted); probably the Buzzards and Eagles, which are but arbitrarily separable, should next range, merging into the Eagle-hawks; or perhaps the Perns, followed by the Elanet group (including *Ictinia*). We are less satisfied of the affinities of the Caracaras, of the Cymindues, and of the Marsh-eagles and Hæmatorns, which last group seems to approximate that of the Hawks.]

THE NOCTURNAL BIRDS OF PREY

Have the head large; very great eyes, directed forwards, and surrounded by a circle of fringed feathers, the anterior of which cover the cere of the beak, and the posterior the orifice of the ear. Their enormous pupils permit so much light to enter, that they are dazzled in full day. Their skull, inflated, but of a slight substance, contains large cavities that communicate with the ears, and probably assist the sense of hearing; but their apparatus for flight is feeble, the furcula offering but slight resistance: their feathers, with soft barbs, and delicately downy, make no noise in flying. The external toe can be voluntarily directed forward or behind. These Birds fly

chiefly during twilight, or by the light of the moon. When attacked by day, or struck by the appearance of some new object, they [the majority of them] do not fly off, but stand more erect, assume grotesque attitudes, and make the most ludicrous gestures.

Their stomach is tolerably muscular, [as compared with the Falcons,] although their prey is wholly animal, consisting of Mice, small birds, [even fish in some instances,] and insects; but is preceded by a large craw, [an inadvertent statement of the author, as the absence of any expansion of the gullet, which is wide, but always of uniform diameter (see fig. 79 *a*), invariably distinguishes the *nocturnal* from all the *diurnal* birds of prey]; the cœca (*b*) are long, and enlarged towards the extremity, &c. Small Birds have a natural antipathy to them, and assemble from all parts to assail them; hence they are employed to attract Birds to the snare. [It may be added, that their tarsi are in no instance scaled, even when denuded of feathers, as in the subdivision *Ketupa;* all of them lay round white eggs.] They form one genus, that of

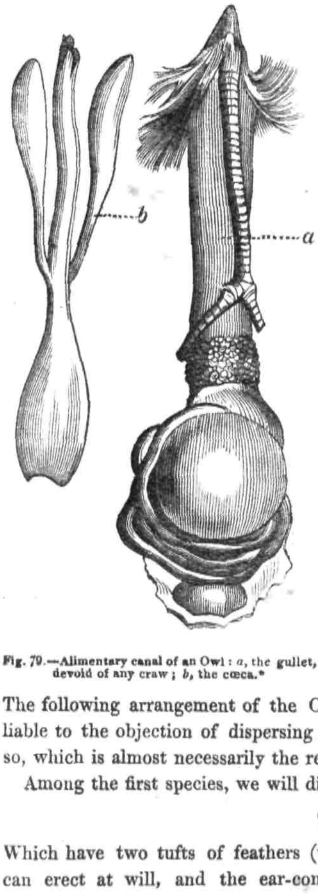

Fig. 79.—Alimentary canal of an Owl: *a*, the gullet, devoid of any craw; *b*, the cœca.*

THE OWLS (*Strix*, Linn.),—

Which may be divided according to their head-tufts, the size of their ears, the extent of the circle of feathers which surrounds their eyes, and some other characters.

Those species which around the eyes have a large complete disk of fringed feathers, itself surrounded by a circle or collar of scaly feathers, and between the two a large opening for the ear (see fig. 80), are more removed in their form and manners from the diurnal Birds of Prey, than those in which the ear is small, oval, and covered by fringed feathers which come from below the eye. Traces of these differences are perceptible even in the skeleton, [though only as regards the degree of stoutness of the bones (see figs. 81 and 84), there being no gradation or transition into the Falcons, either in the skeleton or digestive organs. The following arrangement of the Owls, based on the comparative size of the aperture of the ear, is liable to the objection of dispersing some nearly allied groups, and approximating others that are less so, which is almost necessarily the result of too exclusive attachment to any single character.]

Among the first species, we will distinguish

THE HIBOUX (*Otus*, Cuv.),—

Which have two tufts of feathers (vulg. *horns*) which they can erect at will, and the ear-conch of which (fig. 80), extends in a semicircle from the beak almost to the top of the head, and is furnished anteriorly with a membranous operculum. Their feet are feathered to the toes. Such, in Europe, are

The Long-tufted Hibou (*Str. otus*, Lin.).—Very widely distributed; it inhabits woods, especially those of fir and other evergreens, and breeds generally in deserted Crows' nests: and

The Short-tufted Hibou (*Str. brachyotus*, Lin.).—Found almost every where, [if indeed the same species, which there is reason to doubt: it inhabits open moors, breeds on the ground, and exhibits trifling sexual disparity of size. This bird is scarcely, if at all, dazzled by sun-light: it is the *Brachyotus palustris* of Gould].

Fig. 80.—Ear of Hibou, as observed by raising its anterior flap.

We apply the designation of

* Copied from M. M'Gillivray's Rapacious Birds of Britain.

HOWLETS (*Ulula*, Cuv.)—

To the species which have the beak and ear of the Hiboux, [the latter, however, less developed (see fig. 83)], but not the tufts. They are to be found in the north of both continents: for example,

The Cinereous Howlet (*Str. lapponica*, Gm.).—Almost as large as our Bubow. It inhabits the mountains of the north of Sweden, [and Arctic America].

The Barred Howlet (*Str. nebulosa*, Gm.).—[A common bird of North America, very rare in Europe.]

THE RESTRICTED OWLS (*Strix*, Savigny)—

Have ears as large as in the Hiboux [but of a very different form], and furnished with a still larger operculum; but their elongated beak is only bent towards the end, while in all the other subgenera it curves from the point. They have no head-tufts; their tarsi are feathered [and rather long], but they have hairs only upon the toes: [their middle claw is obtusely serrated: their sternum (fig. 81), shorter than in the others, has its inner notch very slight, and often obliterated.] The mask, formed by the fringed feathers that surround the eyes, is greatly extended, which renders their physiognomy more extraordinary than that of any other night-bird. The species common in France,

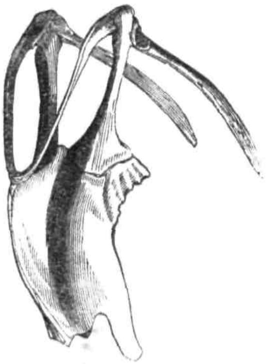

Fig. 81.—Sternum of Barn Owl.

The Barn Owl (*Strix flammea*, Lin., fig. 82), appears to be diffused over the whole globe, [or rather, there are numerous species more or less distinguishable]. It builds in steeples, towers, &c. [and in places distant from the abode of Man, where no hollow trees occur, in the burrows of quadrupeds. When nestling in pigeon-houses, it offers no molestation to the other inhabitants. Its manner of propagation is remarkable; as it produces three or four successive broods, two or more of which, of different ages, commonly occur in the same nest: the young remaining much longer in the nest than those belonging to the other divisions, from which they differ in developing a firmer nestling plumage, similar to the adult garb, and which (as in the Hawks) is not shed before the second autumn. This curious and handsome bird is naturally familiar, and eminently worthy of protection; as it preys solely on small quadrupeds and insects.]

SYRNIUM, Savigny.

The disk and collar of the preceding; but the conch (fig. 83) reduced to an oval cavity, that does not extend to half the height of the skull; they have no head-tufts, but their feet are feathered to the talons. [Notwithstanding the authority of Cuvier, it is proper to remark, that there is no appreciable difference between this and *Ulula*,—certainly none of generical importance. The *Bulaca* of Hodgson appears also to be synonymous.]

The Tawny Howlet (*Strix aluco* and *stridula*, Lin.).—A common European bird, which nestles in the woods, or frequently lays its eggs in the [deserted] nests of other Birds, [though more commonly (if not always) in the hollows of trees, where it abides by day. It is the species so well known for its sonorous hootings. The young are clad at an early age with downy feathers, which are succeeded by the adult plumage previous to their first winter. Their parents often feed them with fish.]

Fig. 82.—Barn Owl.

THE BUBOWS (*Bubo*, Cuv.)—

Are species which, with as small a conch, and the disk of feathers less marked than in the preceding, possess head-tufts. The known species have great feet, feathered to the talons. [They differ from the Hiboux only in their superior size, and the smallness of the auditory aperture.] Such is

The European Bubow (*Str. bubo*, Lin.), or the *Great-horned* or *Eagle-owl*.—The largest of nocturnal Birds [or

which is exceeded in size only by others of this genus. It is little less than the Golden Eagle, and very destructive to Grouse, Hares, and even Fawns: inhabits the mountainous parts of Europe, and is seldom seen in Britain.] Add

The American Bubow (*Str. virginiana*, Daud.)—[Smaller than the preceding, with the grey colour predominating over the fulvous: the Arctic Eagle-owl of the *Fauna Americana-borealis* appears to be only a semi-albino variety. Another species is

The Small-tufted Bubow (*Str. ascalaphus*, Savigny), inadvertently placed by the author in his division *Otus*. It is proper to Asia and Africa, and is occasionally met with in the south-east of Europe. There are several more, certain of which appear to compose the *Huhua* and *Urrhua* of Hodgson.]

Other species occur, in which the aigrettes, wider apart and placed further backward, are elevated with less facility above the horizontal line. Species occur in both continents; as *Str. griseata*, Shaw, from Guiana; and *Str. strepitans*, Tem., from Batavia.

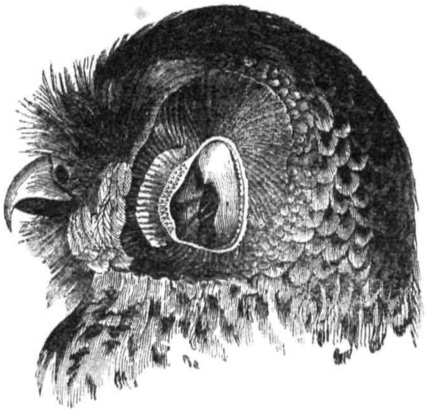

Fig. 83.—Howlet's Ear.

NOCTUA*, Savigny.

Neither tufts, nor an open and deeply set conch to the ear; the aperture of which is oval, and scarcely longer than in other Birds: the disk of fringed feathers is smaller and even less complete than in the Bubows. Their relations to the diurnal Birds of prey are evident, even in their habits, [but not in their internal conformation].

Some are remarkable for a long cuneiform tail, and have their toes densely feathered. They are

THE SURNS (*Surnia*, Dumeril)—

The Rayed Surn (*Str. nisoria*, Wolf; *Str. funerea*, Lin.).—This, the best-known species, from the north of the whole globe, is about the size of the Sparrow-hawk. It hunts more during the day than the night.

The species of the Uralian mountains (*Str. uralensis*, Pallas), is nearly as large as the Harfang. It also hunts during the day, and is sometimes seen in Germany. It is probably the *Hybris* or *Ptynx* of Aristotle.†

There is a species termed Arcadian (*Str. acadica*, Naum), but which belongs to the whole north of the Globe [?] It is the smallest of its tribe, being hardly larger than a Sparrow. It does not avoid the light of day; but Le Vaillant has made known another, from Africa (*le Choucou*, No. xxxviii.), which, according to his account, is very nocturnal. [The former is the *Str. passerina* of Linnæus, but not of British authors, and the *Str. acadica* of Temminck, but not of Gmelin; it is referrible to the *Glaucidium* of Boié, and is not found in America: the *Str. acadica*, Gm., is peculiar to America, and pertains to a very different subdivision, *Nyctale* of Brehm, the members of which are considerably more nocturnal in their habits and adaptments. To the latter group the Choucou of Le Vaillant should also probably be referred. *Ninox* of Hodgson seems to be identical with *Glaucidium*.]

Others have the tail short, and the toes densely feathered: the largest of which, and also the largest night-bird without head-tufts, is

The Harfang (*Str. nyctea*, Lin.), or Great *Snowy Owl*, which almost equals the European Bubow in its dimensions. It inhabits the north of both continents, nestles on elevated rocks, and preys on Hares, Capercalzies, and Ptarmigan. [This bird forms another very distinct division, and is most nearly allied to the Bubows: like them, it does possess head-tufts, which however are small and inconspicuous, though we have seen the bird erect them; its plumage is remarkably firm. The term *Nyctea*, Swainson, has been generically applied to it, with the specific appellation *candida*.]

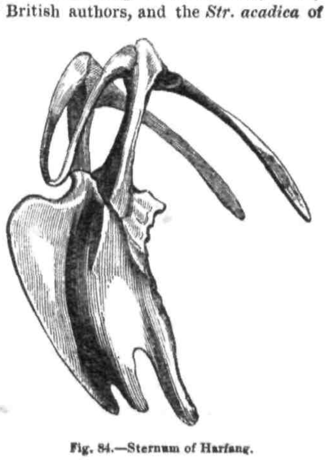

Fig. 84.—Sternum of Harfang.

* This term is falling into disuse, from its having been previously bestowed on a group of insects: it is moreover far from being felicitous, as applied to the most *diurnal* of the Owls.—ED.

† The Prince of Musignano places this remarkable bird in *Syrnium*. I have never seen a specimen, but—to judge from Mr. Gould's figure of it, in the *Birds of Europe*,—should be disposed to elevate it to the rank of a separate division (*Ptynx*): its large and complete ruff distinguishes it from *Surnia*, as its accipitrine form and lengthened tail do from *Syrnium* or *Ulula*.—F.

There are others very much smaller,—such as

Str. Tengmalmi, Gm.—[These have an extended auditory conch, as in the Howlets, like which they are very nocturnal, and unable to endure the light of day. The *Nyctale* of Brehm. The species indicated is peculiar to the Eastern Continent, that confounded with it in the fur-countries of North America, *Str. Tengmalmi*, Richardson, being now dedicated to its enterprising discoverer.]

Fig. 85.—Sternum of Howlet.

But the greater number of these small species have only a few scattered hairs on the toes, [and are nearly allied to the true Surns. They are the *Athene*, Boié]. Such is

Str. passerina, Gm. [and of British authors; *Str. noctua*, Lin.; *Athene noctua*, Bonap.]—It nestles in old walls, [and frequently in chimneys, and has been seen to pursue Swallows on the wing. A remarkable exotic species, with very long tarsi, is the

Str. cunicularia, Molina, or the *Burrowing Owl*, as it has been called; but which, it is most probable, only appropriates the dwellings of burrowing quadrupeds, as the Barn Owl is known to do under similar circumstances; the present species inhabiting the open prairies of America, where there are no trees, and abounding in the *villages* of the Prairie Marmots, as also in the burrows of the Viscachas].

There are yet other *Noctuæ* with unfeathered toes, which approximate the Howlets in size. Cayenne supplies several fine species, and particularly the three following:—

Str. cayennensis, Gm.; *Str. lineata*, Shaw, or *Str. albomarginata*, Spix; and *Str. torquata*, Daud.—The two first of these equal in size the Tawny Howlet, and the last is still larger.

Finally, there are some in America, which have the tarsi, in addition to their toes, denuded of feathers; of which the

Str. nudipes, Daud., may be cited in illustration.

THE SCOPS (*Scops*, Savigny),—

With ears proportioned to the size of the head, the incomplete disk and naked toes of the preceding, combine aigrettes analogous to those of the Bubows and Hiboux.

One inhabits Europe (*Str. scops*, Lin.)—Scarcely larger than a Blackbird, [and there are many others].

Some foreign species occur of rather large size, with the legs, as well as the toes, naked. [They constitute the subdivision *Ketupa*.] Such are

Str. Ketupa, Tem., and *Str. Leschenaulti*, Id., which may possibly prove to be identical. [These Birds are essentially Bubows, with long and naked tarsi, the skin of which corrugates in dry specimens, so as to present somewhat the appearance of being covered with reticulated scales, which is not the case. Their toes are very rough underneath, as in the Ospreys; and like them they prey chiefly on fish, and sometimes crustaceans. The *Cultrunguis* of Hodgson appears to be a synonyme of this subdivision.

The great group of Owls falls naturally into three distinct sections, distinguishable at the first glance; and two of these sections comprehend species which differ exceedingly in the magnitude of the external ear.

The first comprises all that are decorated with aigrettes, or what are popularly termed *Horned Owls*; as the divisions *Nyctea*, *Bubo*, *Ketupa*, *Scops*, and *Otus*.

In the second section, the whole of the tuftless species should be brought together, excepting those constituting the subdivision *Strix* of Savigny. They mainly differ in their degrees of adaptation for nocturnal or semi-diurnal habits.

The third is composed of the restricted genus *Strix*, or the Barn Owls, and is much more distinct from both the others, than the latter are *inter se*. The aspect of the living bird is very different in these three primary sections.]

THE SECOND ORDER OF BIRDS.

THE PASSERINÆ.

This is the most numerous order of the whole class. Its character seems, at first sight, purely negative, for it embraces all those Birds which are neither swimmers, waders, climbers, rapacious, nor gallinaceous. Nevertheless, by comparing them, a very great mutual resemblance of structure becomes perceptible, and particularly such insensible gradations from one genus to another, that it is extremely difficult to establish the subdivisions.

They have neither the violence of the Birds of Prey, nor the fixed regimen of the Poultry and Water-fowl; insects, fruit, and grain, constitute their food, which consists more exclusively of grain as the beak is stouter and stronger, and of insects as it is more slender. Those in which it is strong even pursue other Birds.

Their stomach is a muscular gizzard. They have, generally, two small cœca: and it is among them that we find the singing Birds, and the most complicated inferior larynx.

The proportional length of their wings and the power of their flight are as various as their habits.

The adult sternum has ordinarily but one emargination on each side of its posterior border. There are, however, two in the Rollers, Kingfishers, and Bee-eaters, [also in the Colies, Motmots, and Todies, which the author includes in this group,] and none whatever in the Swifts and Humming-birds.

We institute our first partition according to the feet, and have then recourse to the beak.

The first and most numerous division comprehends those genera in which the external toe is connected to the middle one as far as the first or second joint only.

[This ordinal subdivision, properly restricted, is one of the most rigorously defined throughout nature, quite as much so as that of the Parrots.

The entire skeleton, digestive and vocal organs, are peculiar; and those genera included by the author which differ in one particular differ also in the rest, and accord in all their essential characters with another great group that follows.

The lower larynx is always complicated, and operated upon by four distinct pairs of muscles; besides which, the long sterno-tracheal pair—found in most other Birds—is generally present, but reduced to extreme tenuity. This character excludes the Cuvieran genera *Cypselus, Caprimulgus, Podargus, Colius, Coracias, Colaris, Upupa, Merops, Prionites, Alcedo, Ceyx, Todus,* and *Buceros,*—ten of which have also no intestinal cœca, and the three others very large cœca, exactly resembling those of the Owls (fig. 79). All the remaining genera, except the Humming-birds, which also require to be excluded, have two minute cœca.

With the sole exception again of the Humming-birds, which have the lower larynx differently complicated, all *singing Birds* belong to this great order: the conformation alluded to enables them to inflect and modulate the voice; though there are many species, possessing the same structure, which nevertheless utter only monotonous cries, and others of which the notes are harsh and little varied; even these, however, are very generally capable of being taught to speak, to whistle airs, and to imitate almost any sound; and in such individuals as cannot be brought to do so, it by no means follows that there is any physical deficiency, as indicated by the diversity noticeable in this respect in individuals of the same species: there are indeed very few of them, if any, that do not *sing,* or utter some peculiar note or chatter analogous to song, during the season of courtship.

The sternal apparatus, whether of a Swallow or Tree-creeper, a Promerops, Finch, Crow, Thrush, or Manakin, presents invariably the same peculiar characters, with scarcely any modification. The long manubrial process in front between the coracoids, with slantingly truncate bifurcate tip; the costal process, expanding anteriorly much beyond the articulations of the

ribs; the single deep and angular posterior emargination, reduced to a foramen in some; the long, slender, and curving furcula, with invariably a compressed *vertical* appendage;—all are characters that at once indicate the present order, and exclude every one of the genera that have been enumerated.

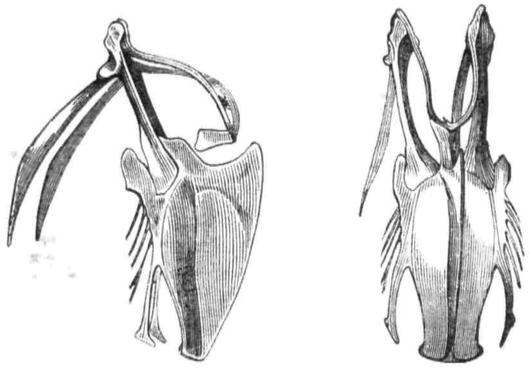

Fig. 86.—Sternum of Haw Grosbeak.

They have constantly a large brain, and characteristic form of skull, excepting in one genus*; twelve tail-feathers, another character which excludes the genera *Cypselus, Caprimulgus, Podargus, Colius, Upupa. Trochilus*, and *Buceros;* and their clothing feathers have rarely any trace of the supplementary plume, which is never developed beyond a few downy filaments. All of them are hatched naked, and in nearly every instance from coloured or speckled eggs, larger at one end, and in a nest constructed and generally *interwoven* by the parents,—extremely few other Birds doing more than heaping together a quantity of materials.

The toes are formed for perching; and are always three before and one hindward, the outward and middle toes being in every instance connected to the first joint, and sometimes further.]

The first family of this division is that of

THE DENTIROSTRES,—

Wherein the upper mandible is notched on each side toward the point.† It is in this family that the greatest number of insectivorous Birds occur; though many of them feed likewise on berries and other soft fruits.

The genera are determined by the general form of the beak, which is stout and compressed in the Shrikes and Thrushes, flattened in the Flycatchers, round and thick in the Tanagers, and slender and pointed in the Pettychaps group; but the transitions from one to another of these forms are so gradual that it is very difficult to limit the genera.

[The study of the changes of plumage, and even colours and markings, affords considerable assistance in determining the affinities of the various genera,—more so, perhaps, than any other character.]

THE SHRIKES (*Lanius*, Lin.)—

Have a conical or compressed beak, more or less hooked at the point.

THE SHRIKES, properly so called, (*Lanius*, Vieillot)—

Have it triangular at the base, with compressed sides. They live in families [for a few weeks after the breeding season], fly irregularly and precipitately, uttering shrill cries; nestle on trees [or in bushes]; lay five or six eggs, and take great care of their young. They have the habit of imitating, in the wild state, part of the songs of such Birds as live in their vicinity. The females [?] and young are generally marked with fine transverse lines on the upper parts.

Some have the upper mandible arched; those in which its point is strong and much hooked, and in which the notch forms a small tooth on each side, manifest a degree of courage and cruelty which has led to their association with the Birds of Prey by many naturalists. In fact, they pursue other Birds, and successfully defend themselves against the larger ones, even attacking the latter whenever they intrude in the vicinity of their nest.

* *Malurus;* the different species of which are singularly variable in this respect

† No trace of this notch is ever visible in the bone, from which the "tooth" of certain *Accipitres* is a true process.—ED.

There are four or five species of this subdivision in Europe, as

The Sentinel Shrike (*L. excubitor*, Lin.)—As large as a Thrush, and ash-coloured above, white underneath: the wings, tail, and a band crossing the eyes, black; some white on the scapulars and tail. It resides all the year in France, [and is chiefly known as an uncommon winter visitant in Britain].

The Red-backed Shrike (*L. collurio*, Gm.)—Smaller, with the head and rump ash-coloured, the back and wings reddish-brown, a black streak through the eyes, lower parts whitish, tinged with pinkish lilach, wings and tail dull black, the side feathers of the latter white at the base externally. [Female, brown above, without transverse striæ, and sometimes attaining the masculine livery with age.] It destroys other Birds, young Frogs, and a vast number of insects, which it impales on the thorns of bushes, to devour at leisure, [a habit common to the whole genus, whence they have derived the name of *Butcher-birds*. We may here remark that the Shrikes have great power of clutching with their toes, and always hold their prey in one foot, resting on the tarsal joint of that foot, unless when they have fastened it upon a thorn, when they pull it to pieces in a contrary direction. The present species feeds much on small mammalia, as Shrews and the smaller Voles, captures insects on the wing in the manner of a Flycatcher, and is a common summer visitant in the southern counties of England].

The Wood Shrike (*L. rufus*, Gm.)—Wings and tail nearly as in the preceding, the band across the eyes meeting over the forehead, the head and neck bright rufous, back black, the scapulars, rump, and lower parts, white. [Sexes almost similar. A summer visitant, of very rare occurrence in Britain. There are two others in Europe, allied to the first, *L. minor*, Gm., and *L. meridionalis*, Tem.; and many more in Asia, Africa, and America, some of the former having shorter wings, and a longer and more cuneated tail.]

There are numerous exotic species with arcuated beaks, the points of which diminish by degrees, till it becomes impossible to define the limits between them and the Thrushes.

The genus *Lanio* of Vieillot is founded on one of them, the edges of the upper mandible of which are slightly angular. It is the *Tangara mordoré* of Buffon, (*Tan. atricapilla*, Gm.)

Various species with feeble bills constitute the *Laniarius* of Vieillot. (*Gal. Ois.* 143.)

The Vireoles (*Vireo*) of the same naturalist chiefly differ in the shortness and slenderness of the bill. [They constitute a very distinct genus, consisting of the *warbling Flycatchers* of North America, as *Muscicapa olivacea*, Wils., and many proximate species, which are allied to the Pettychaps group (the restricted *Sylvia*, or *Phillopneuste*) of Europe: they are to a considerable extent baccivorous.]

Other Shrikes have the superior mandible straight, and abruptly hooked at the tip. They are all foreign, and grade towards the Fauvettes and other slender-billed *Dentirostres*.

[They constitute the *Thamnophilus* of Vieillot, as now generally accepted, wherein the plumage is soft and puffy, and conspicuously barred across at all ages, these markings being in some instances broken into spots, as in the nestling dress of the Thrushes, to which and the true Shrikes they are intermediate, passing to the Thrushes through *Ianthocincla*. They are also related to the Antcatchers, and are indigenous to South America].

Some of them have a straight and very strong beak, the lower mandible of which is much inflated;

As *L. lineatus*, Leach, (*Zool. Misc.* pl. vi.), *Thamnophilus guttatus*, Spix.

Others, again, with a straight and slender bill, are remarkable for their crests of vertical feathers;

As *L. plumatus*, Shaw; of which Vieillot makes his genus *Prionops*, and *le Manicup* of Buffon (*Pipra albifrons*, Gm.), which has nothing in common with the true *Pipræ*, beyond a more than usually prolonged junction of the two outer toes. M. Vieillot makes of it his genus *Pithys*. (*Gal.* 129.)

Among these Shrikes, more particularly so called, some other exotic subgenera, that differ more or less, require to be specified. Such are

THE VANGAS (*Vanga*), Buffon,—

Distinguished by a large beak, very much compressed throughout, its tip strongly hooked, and that of the lower mandible bent downward.

The Vanga (*L. curvirostris*, Gm.), and also some newly-discovered species, as *V. destructor*, Cuv., &c.

THE LANGAREYS (*Ocypterus*, Cuv.; *Artamus*, Vieillot)—

Have the beak conical and rounded, without any ridge, somewhat arched towards the tip, with a very fine point, slightly emarginated on each side. Their feet are very short, and the wings in particular reach beyond the tail, which renders their flight similar to that of a Swallow; but they have the courage of the Shrikes, and do not fear to attack even the Crow.

Numerous species inhabit the coasts and islands of the Indian Ocean, where they are continually seen on the wing, flying swiftly in pursuit of insects.* [They are unquestionably allied to the following.]

THE BARITAHS (*Barita*, Cuv.; *Cracticus*, Vieillot)—

Have a large and straight conical beak, round at its base,—where it extends circularly backward upon

* Consult a monograph of this genus, by M. Valenciennes, published in *Mem. du Mus.*, tom. vi. p. 20.

the forehead, occupying the site of the frontal feathers,—laterally compressed, and emarginated. The nostrils, small and linear, are not surrounded by a membranous space.

They are large birds of Australia and the neighbouring islands, which naturalists have arbitrarily dispersed in several genera. They are said to be very noisy and clamorous, and pursue small Birds: [are also docile, and readily learn to whistle airs with remarkable power and execution].

THE CHALYBEANS (*Chalybæus*, Cuv.)—

Have the beak similar to that of the Baritahs, except that it is rather less thick at the base, and the nostrils are pierced in a large membranous space. The known species are indigenous to New Guinea, and are remarkable for their fine tints, resembling burnished steel.

The Paradisian Chalybean (*C. paradisæus*, Cuv.; *Paradisæa viridis*, Gm.).—The feathers on the head and neck like curled velvet, which, together with the lustre of its hues, has caused it to be ranked among the Birds of Paradise.

The Tufted Chalybean (*C. cornutus*, Ill.; *Barita Keraudrenii*, Lesson).—Two pointed tufts of feathers on the occiput; and the trachea forms three circles before it reaches the lungs.*

THE PSARAS (*Psaris*, Cuv.; *Tetyra*, Vieillot,)—

Have a conical beak, very thick, and round at its base, but not extending backward upon the forehead; the point is slightly compressed and hooked.

The species inhabit South America, and that best known is

The Cayenne Psara (*Lanius cayanus*, Gm.), which is ash-coloured, with the head, wings, and tail, black. Its manners resemble those of the Shrikes. There are many others.

THE CHOUCARIS (*Graucalus*, Cuv.)—

Have the bill less compressed than in the Shrikes, the ridges of its upper mandible sharp, and regularly arcuated throughout its length; the commissure of the beak is slightly arched. The feathers which sometimes cover the nostrils have occasioned them to have been approximated to the Crows, but the emargination of the beak removes them from that genus [?]

They inhabit, like the Baritahs, the remotest parts of the Indian Ocean. Some have very brilliant plumage, and compose the *Pirola* of Temminck, or *Ptilonorhynchus*, Kuhl, founded on the head-feathers being more like velvet. *Sphecotheres*, Vieillot, only differs from the others in being rather more naked round the eyes.

To the Choucaris may be approximated one of the most beautiful of the birds lately discovered in those regions, the *Coracias puella*, Lath.; *Irena puella*, Horsf.; *Drongo azuré*, Tem.; a Javanese species, of a velvet black, the back of which is of the most splendid ultramarine blue that can possibly be imagined.

THE BETHULES (*Bethylus*, Cuv.; *Cissopus*, Vieillot).

The beak thick, short, uniformly bulging, and slightly compressed towards its tip.

We know but of one, which has the form and colours of our common Magpie—(*Lanius leverianus*, Shaw; *L. picatus*, Latham).

THE FALCONETS (*Falcunculus*, Vieillot)—

Have a compressed beak, almost as high as long, with the ridge of the upper mandible arcuated. [They are merely Tits, with a somewhat shrike-like bill, and resemble our common *Pari* in their manners, notes, nidification, eggs, and plumage].

The Crested Falconet (*Lanius frontatus*, Latham).—Size of a Sparrow, and nearly the same colours as our common Great Tit: the coronal feathers of the male form a crest. It inhabits New Holland. [Some of the *Malaconoti* are nearly allied.]

THE PARDALOTES (*Pardalotus*, Vieillot)—

Have a short beak, slightly compressed, the upper mandible with a sharp arcuated ridge, and its tip emarginated. They are very small birds, with a short tail.

The best-known species (*Pipra punctata*, Shaw), is partly sprinkled with white, like an Amaduvat. From New Holland, [where there are many others].

THE FLYCATCHERS (*Muscicapa*, Lin.)—

Have the beak horizontally depressed, and armed with bristles at its base, with the point more or less decurved and emarginated. Their general habits are those of the Shrikes; and, according to their size, they prey on small Birds or Insects. The most feeble of them pass by insensible gradations into the slender-billed warblers. We divide them as follow.

* This is the only modification of the trachea we have heard of among the *Passerinæ*.—ED.

THE TYRANTS (*Tyrannus*, Cuv.)—

Have a long, straight, and very stout bill; the ridge of the upper mandible straight and blunt; its point abruptly hooked. They are American birds, of the size of our Shrikes and equally spirited, which defend their young even against Eagles, and drive all Birds of prey from the vicinity of their nest. The largest species prey on smaller birds, and do not always disdain those they find dead. [They have even been observed to plunge after fish in the manner of a Kingfisher; and have been sometimes noticed to throw up their food and catch it in the throat, as in the Toucans, Hornbills, &c.

The species are extremely numerous, and have been further subdivided by different systematists. Thus, several with extremely furcate tails compose the *Milvulus*, Swains., and the smaller and weaker species the *Tyrannula* of the same nomenclator: the latter grade into the Kinglets. Others constitute the *Platyrynchus*, Vieillot, &c. The majority have yellow or red coronal feathers, somewhat as in the Kinglets.]

THE MOUCHEROLLES (*Muscipeta*, Cuv.)—

Have a long beak, very much depressed, and twice as broad as high, even at the base; the ridge of the upper mandible very obtuse, but sometimes however the reverse; the edges slightly curved, the points and emargination feeble, and long vibrissæ at the gape.

Their weakness disables them from preying on aught but insects. All of them are foreign; and many are ornamented with long tail-feathers or with fine crests, or at least have vivid colours on the plumage.

[Several different natural groups are here brought together: the term is now generally restricted to some beautiful birds of the eastern hemisphere, the males of which have crimson and black plumage, and long even tails, the females being yellow where the male is red; their colours are distributed as in the Redstarts, and there are other birds of similar form and colouring, but stouter and larger, which compose the *Phœnicornis*, Gould.]

Some species approximating the Moucherolles [or rather the Tyrants],—

THE FLATBILLS (*Platyrynchus*, Vieillot),—

Are remarkable for having the bill still broader and more depressed.

[They have been confused by many writers with the Todies, a widely separated genus, that does not even possess the distinctive characters of the *Passerinæ*. They have also been ranged under many named minor subdivisions.]

Others, which have also the beak broad and depressed, are distinguished by their longer legs and short tail. They compose the genus

CONOPOPHAGA, Vieillot,—

Of which but two or three species are known, all from America, that subsist on Ants, which has caused them to be ranged with the small tribe of Thrushes termed Antcatchers.

THE RESTRICTED FLYCATCHERS (*Muscicapa*, Cuv.)—

Have shorter bristles at the gape, and the bill more slender than in the Moucherolles. It is still, however, depressed, with an acute ridge above, a straight edge, and the point a little curved downward. [They are closely related by affinity to the Chats and Redstarts, as are also the Moucherolles, and have similar mottled nestling plumage, a character that does not occur in the great Tyrant group.

Four species inhabit Europe, migrating southward in winter.]

The Grey Flycatcher (*M. grisola*, Gm.)—Grey above, whitish underneath, with some greyish streaks on the breast. [It is very common throughout Britain, seldom arriving before May: one of the least musical of our native Birds. Its legs are shorter than in the following, and general character different: hence, with some others from Africa, it composes the *Butalis* of Boié.]

The Collared Flycatcher (*M. albicollis*, Tem.), is very remarkable for the changes of plumage [or rather of colouring only] which the male undergoes seasonally. Resembling the other sex in winter, that is to say, grey [on the upper parts] with a white patch on the wing, it attains towards the nuptial season an agreeable distribution of pure black and white, the head, back, wings and tail, being of the former colour, and the forehead, a collar round the neck, a great patch on each wing, a smaller one in front of it, and the outer edge of the tail, white. It nestles in the trunks of trees.

Another species subject to the same changes has more recently been discovered, in which the neck of the male is black like the back in the nuptial season, and which wants the small white spot on the edge of the wing. It is the Pied Flycatcher (*M. luctuosa*, Tem.), which is found further northward than the other. [This species is remarkable for its local distribution in the British islands, being very common near the lakes of the north of England, and of rare occurrence elsewhere. It is doubtful whether the other ever occurs here. They are said to differ in their notes, and both lay blue eggs, whereas the Grey Flycatcher lays whitish eggs spotted with brown. The two pied species are also comparatively musical.]

The fourth was discovered in Germany, [in some parts of which it is common It is smaller than the others, with plumage resembling that of a Robin; constitutes the division *Erythrosterna* of Bonaparte].

The beak of the Flycatchers becomes more and more slender, till it finally approaches that of some Kinglets.

Some species, wherein the ridge of the upper mandible is more raised, and arched towards the tip, lead to the Chats and Wheatears. Certain of these appear to compose the *Drimophilus* of Temminck.

There are also several genera or subgenera closely allied to different links of the great series of Flycatchers, although they much surpass them in size. Such are

THE BALD TYRANTS (*Gymnocephalus*, Geof.),—

Which have nearly the same beak as the Tyrants, only that its ridge is rather more arcuated, and a great part of the face is destitute of feathers.

We know but of one species, from Cayenne, as large as a Crow, and the colour of Spanish snuff.

THE DRAGOON-BIRDS (*Cephalopterus*, Geof.)—

Have, on the contrary, the base of the bill adorned with feathers, which, radiating at top, form a large crest resembling a parasol.

Only one species is known, from the banks of the Amazon; of the size of a Jay, and black: the feathers on the lower part of its breast form a sort of pendent dewlap—(*C. ornata*, Geoff.; *Coracina cephaloptera*, Vieillot; *Cor. ornata*, Spix.)

THE COTINGAS (*Ampelis*, Lin.)—

Have the beak compressed, as in the generality of Flycatchers, but proportionally rather shorter, tolerably wide at base, and slightly arcuated.

Those in which it is strongest and most pointed, retain a very insectivorous regimen. They are named

PIAUHAUS (*Querula*, Vieillot)—

From their cry, and inhabit America, where they live in flocks in the woods, and pursue insects.

Such are the Common Piauhau (*Muscic. rubricollis*, Gm.), black with a purple throat; and the Great Piauhau, entirely purple, (*Cotinga rouge*, Vaillant; *Coracias militaris*, Shaw). The Grey Cotinga (*Amp cinerea*) resembles the Piauhaus rather than the genuine Cotingas. The Golden-throated Piauhau (*Coracias scutata*, Lath., or *Coracina scutata*, Tem.), has a smaller beak, and approximates the Bald Tyrant.

THE RESTRICTED COTINGAS (*Ampelis*, Vieillot),—

In which the beak is rather weaker, feed on berries and soft fruits, in addition to insects. They inhabit humid places in South America; and the greater number are remarkable, at the breeding season, for the splendour of the azure and purple which adorn the males. During the rest of the year both sexes are grey or brown.

The Scarlet Cotinga (*A. carnifex*, Lin.)—Crown, rump, and belly scarlet; the rest brownish-red: fourth quill of the wing narrowed, shortened, and tough or horn-like. The Pompadour Cotinga (*A. pompadora*, Lin.).—Of a lovely reddish purple, with white quill-feathers. The Blue Cotinga (*A. cotinga*, Lin.).—Splendid ultramarine, with a violet breast, frequently traversed by a large blue band, and spotted with dark yellow. There are others equally handsome.

THE TERSINES (*Tersina*, Vieillot)—

Are Cotingas with the beak wider at its base. As

The Tersine of Buffon (*Amp. tersa*, Gm.; *Procnias tersina*, Tem., or *Pr. hirundinacea*, Swainson).

THE CATERPILLAR-HUNTERS (*Ceblepyris*, Cuv.; *Campephaga*, Vieillot),—

With the beak of the Cotingas, have a singular character, which consists in the somewhat prolonged stiff, and spiny shafts of their rump-feathers. They inhabit Africa and India, and feed upon Caterpillars, which they find on the highest trees; but they have none of the brilliancy of the Cotingas. Their tail, somewhat forked in the middle, is rounded at the sides.

Such are the Grey and Black Caterpillar-hunters of Vaillant (the former of which is the *Muscic. cana*, Gm.). The Yellow C. of the same naturalist is the young of *Turdus phenicopterus*, Tem. Add *C. fimbriatus*, Tem. Col. 249, 250.

We may also distinguish

THE WAXWINGS (*Bombycilla*, Brisson),—

The head of which is adorned with [erectible] feathers, longer than the rest, and they have besides

a singular character in the secondary quills of the wing, the ends of which [at least in two of the three species, are converted into] smooth, oval, red disks, [much resembling red sealing-wax].

There is one in Europe, the Common Waxwing (*Amp. garrulus*, Lin.), [and which also occurs in America westward of the Rocky Mountains, and in Asia to China and Japan.] It is less than a Thrush, with soft vinous-grey plumage, the throat black; tail black, tipped with yellow, [with minute scarlet lobes resembling those on the wing-secondaries in old specimens*, wherein the primary quills also are each terminated with white, forming a series of transverse markings]; wings black, variegated with white [and yellow]. This bird appears in flocks, at long intervals, and without regularity, from which circumstance its presence was long considered an evil omen. It is not timorous, is easily captured and kept in captivity, eats of every thing, and a great quantity, [but in the wild state is principally baccivorous, and in times of necessity has been seen to eat the buds and sprouts of various trees: it flies rapidly, and has a low warbling song]. This bird is supposed to breed very far to the north. Its flesh is esteemed good eating.

There is a very similar but smaller species in America (*Amp. garrulus, B.*, Lin.; *A. americana*, Wils.; *B. carolinensis*, Brisson; *B. cedrorum*, Vieillot), [the *Cedar-bird* of the Anglo-Americans: it inhabits eastward only of the Rocky Mountains.]

A third, in Japan (*B. phœnicoptera*, Tem.), has no wax-like appendages to the wings, and the tail and lesser wing-coverts are tipped with red. [Its size equals that of the first.]

M. M. Hofmansegg and Illiger have separated, with equal propriety,—

THE CAMPANERO and some others (*Procnias*, Hof.),—

Wherein the beak, weaker and more depressed, opens nearly as far as the eye. They are indigenous to South America, and subsist on insects.

They require to be subdivided into

THE CAMPANEROS (*Procnias*, as restricted),—

Which have feathered throats.

One species (*Amp. carunculata*, Gm.), distinguished by a long soft caruncle at the base of its beak, is white when adult, greenish when young. [This is the celebrated Campanero or *Bell-bird* of Guiana, the loud sonorous voice of which, heard from time in the depths of the forest, during the stillness of mid-day, exactly resembles the tolling of a bell.]

Others,

THE AVERANOS (*Casmarhynchus*, Tem.),—

Have naked throats.

There is one in which the naked part of the throat of the male is covered with fleshy caruncles: the Averano of Buffon (*Amp. variegata*, Lin.). Another (*Procn. araponga*, Pr. Max; *Casm. ecarunculatus*, Spix) has some small thinly-scattered feathers on the same place. These birds also are white in the adult state, and have the females and young greenish.

Finally, we place at the end of the Cotinga group,

THE GYMNODES (*Gymnoderes*, Geoff.),—

The beak of which is only a little stouter, but the neck is partly naked, and the head covered with velvety feathers.

The species known is from South America, and in great part frugivorous. It is the size of a Pigeon, and black, with bluish wings. (The *Gracula nudicollis*, Sh.; *Corvus nudus* and *Gracula fetida*, Gm.).—N.B. M. Vieillot brings the Choucaris, Gymnode, and Dragoon-bird together, to form his genus *Coracina*.

THE DRONGOS (*Edolius*, Cuv.; *Dicrurus*, Vieillot)—

Also pertain to the great series of Flycatchers. Their beak is equally emarginated and depressed, its upper ridge acute; but they are distinguished by having both mandibles slightly arcuated throughout their length: the nostrils are covered with feathers, besides which there are long hairs forming moustaches. [These interesting birds exhibit a flycatching modification of the great corvine type].

The species are numerous in the countries bordering the Indian Ocean, and are generally glossy black, with a forked tail, [the outermost feathers of which are often extremely long, with a naked shaft except at the base and tip: they are gregarious, assembling towards the evening, and subsist on insects, particularly Bees and Wasps, for which they hawk in the vicinity of the hive; are popularly termed *Devil-birds*]. It is said that some of them sing as finely as a Nightingale.

The genus *Sparactes* of Illiger was founded on a disguised specimen of one of these birds, decorated with feathers not its own by a dealer, and the legs of a Hoopoe.

* This tends to corroborate a remark in p. 156, wherein the tail-feathers are stated to correspond to the wing-secondaries, excepting the middle pair, or uropygials, which represent the wing-tertiaries.—ED.

THE PHIBALURES (*Phibalura*, Vieillot)—

Have an arcuated ridge to the bill, as in the Drongos, but the beak is shorter than the head.

The only known species (*Ph. flavirostris*, Vieillot) inhabits Brazil, and has a deeply-forked tail; its plumage is spotted with black and yellow, and there are some red feathers on the head, which recal to mind the Tyrant Flycatchers. [*This is a very curious species, which is closely related to the Swallows, as well as the Cotinga* group, and to the Tyrants.]

THE TANAGERS (*Tanagra*, Lin.)—

Have a conical beak, triangular at its base; the upper mandible emarginated towards the tip, with its ridge arcuated; wings and flight short. They resemble the Sparrow tribe in their habits, and feed on grain as well as on insects and berries. The greater number are conspicuous in our collections for their brilliant colours. [All are peculiar to America.] We subdivide them as follow:—

THE LINDOS (*Euphonia*, Vieillot?)—

Or *Bullfinch Tanagers*, which have a short beak when viewed vertically, bulging on each side of its base: their tail is proportionally shorter than in the others.

Such are the *Tanagra violacea, cayennensis, diademata, viridis, chrysogaster* [and several others. The Spanish name *Lindo*, applied by Azara, intimates their brilliancy].

THE FINCH-TANAGERS (*Habia*, Vieillot)—

Have a thick, bulging, conical bill, as broad as high, the upper mandible of which is rounded above.

Such are *Tan. flammiceps*, Pr. Max., *T. superciliosa, psittacina*, and *atricollis*, Spix, &c.

THE TANAGERS, properly so called,—

Have a conical beak, shorter than the head, as broad as high, the upper mandible arcuated and slightly pointed.

T. episcopus, multicolor, and numerous others [many of them remarkable for the variety of contrasting, brilliant hues, which variegate and adorn their plumage].

T. talas and some others have been separated by Mr. Swainson under the name *Aglaia*.

THE ORIOLE-TANAGERS (*Tachyphonus*, Vieillot),—

Have the beak conical, arcuated, pointed, and notched towards the tip.

T. cristata, Tem., of which *T. brunnea*, Spix, is the young, and various others.

The *T. gularis* and *pileata*, Tem., and *T. speculifera*, Spix, approximate the *Bec-fins* in the slenderness of their bills. "Mr. Swainson makes of them his genus *Spermagra*."

The *Pyranga* of Vieillot is founded on an individual deformity. We will designate his species *T. cyanictera*.

In the *Palmiste*, Buff., the emargination of the upper mandible is very slight, and it almost entirely disappears in a proximate species, of which M. Vieillot has formed his genus *Icteria*. This bird is the *Pipra polyglotta*, Wilson, [a very curious species, the affinities of which are by no means obvious]. It conducts to the Weavers.

THE CARDINAL-TANAGERS [(*Pyranga*, as now generally accepted)],—

Have a conical and slightly bulging beak, with an obtuse salient dentation on each side.

T. mississipiensis, Tem., or *T. æstiva*, Wils. Also *T. rubra* and *T. ludoviciana*, Wils., &c.

Lastly,

THE RHAMPHOCELE-TANAGERS (*Jacapa*, Vieillot),—

Have a conical beak, the rami of the lower mandible of which are enlarged behind.

Such are *T. jacapa* and *brazilia*, Tem., and *T. nigrogularis*, Spix.

[We may remark that the great group of Tanagers is simply a ramification of the Cotinga family, peculiar to the same restricted locality.]

THE THRUSHES (*Turdus*, Lin.)—

Have the beak arcuated and compressed; but its point is not hooked, and the lateral emargination does not produce so marked a dentation as in the Shrikes. Nevertheless. as already stated, there are gradual transitions from one to the other of these genera.

The regimen of the Thrushes is more frugivorous: they feed much on berries, and their habits are solitary. [The majority are however gregarious during the winter; and some (as our common Fieldfare) even throughout the year.]

The name of Merle is applied to those species, the colours of which are uniform or distributed in large masses. [They are generally also more bulky; but pass, by insensible gradations, into the spotted-breasted Thrushes.]

The Black Merle, or *Blackbird* (*T. merula*, Lin.)—Male entirely black, with the bill and eyelids yellow; female blackish brown, reddish and more or less spotted on the breast, [beak seldom wholly yellow. The plumage is soft, and wings short and rounded]. A mistrustful species, which however is easily tamed, and sings finely, having even been taught to speak. [It is generally seen in pairs, and is at no season gregarious: appears to be peculiar to Europe, being replaced by an allied species (*T. pœcilopterus*) eastward.]

The Ring Thrush (*T. torquatus*, Lin.).—Black, with the feathers bordered with whitish, and a conspicuous white gorget on the breast. [All the proportions of this bird exactly correspond, even to minutiæ, with those of the Fieldfare, which is placed by many systematists in a different named division. The Ring Thrush inhabits bleak and upland moors, chiefly in the north of Europe, and migrates far southward at the close of autumn. It is a loud but inferior songster, and common only in a few districts of Britain.]

The lofty mountains of the south of Europe sustain two species (*T. saxatilis*, Lin., and *T. cyaneus*, Lin.). The first, which is more frequently seen northward, is better known. It sings finely, and nestles in steep rocks, or ruined buildings. [These Birds, which with various others constitute the *Petrocincla*, Vigors, and have since even been separated into minor groups, form a natural division apart from the other Thrushes, and are allied to the Chats and Wheatears, which they much resemble in habit. They are not found in Britain.]

The term Thrush is applied more particularly to the species with spotted plumage, that is to say, marked with black or brown spots on the breast. There are several in Europe, which assemble in large flocks in winter, and migrate southward.

The Missel Thrush (*T. viscivorus*, Lin.)—Is the largest [with one exception] of the whole genus. [It is uniform yellowish-brown above, and tinged with sulphur-yellow on the under parts, which are speckled with transverse spots; beneath the wings white. Is common throughout Britain, and resident at all seasons; feeding principally on berries the young alone associate in large flocks about October, which soon separate and disperse. This bird is very wild and distrustful, except at the season of propagation, when it affects the vicinity of human habitations, and is remarkable for the spirit with which it attacks and drives away Magpies, &c. from near its nest, uttering a loud rattling screech: it always builds on trees; and is a powerful but monotonous songster, heard nearly throughout the year.]

The Fieldfare Thrush (*T. pilaris*, Lin.).—Distinguished by the ash-colour of the neck and rump, [dark reddish colour of the back, &c. Is remarkable for generally nestling in society, being gregarious throughout the year; visits Britain in large flocks about November, and departs late in spring; is the least musical probably of the whole genus].

The Song or Mavis Thrush (*T. musicus*, Lin.).—[Brown above, yellowish on the breast, which is spotted with black; fulvous beneath the wings. It is the finest songster of the European species, and is seldom observed in flocks in Britain, where it is resident at all seasons. This bird is a great destroyer of snails.]

The Redwing Thrush (*T. iliacus*, Lin.)—Smaller than the preceding, the flanks and beneath the wings, deep rufous; [back brown, inclining to olive green; a conspicuous pale streak over the eye; and longitudinal markings on the under parts. This bird is a common winter visitant in Britain, arriving always some weeks before the Fieldfare, and keeping in more straggling flocks, the individuals of which depart gradually in spring, and not simultaneously, as in that species. It is an inferior songster.

Allied to the Fieldfare, Redwing, and Ring Thrushes, are numerous foreign species, two of which—of intermediate character to those mentioned—occur in Eastern Europe, *T. Naumanni* and *T. atrogularis;* others, related to the Redwing and Mavis, all of which are proper to the eastern parts of Asia, including Japan, have slaty-black plumage, more or less relieved, to which group the *T. sibiricus*, which has also been met with in the east of Europe, appertains. There are foreign species of this extensive genus intermediate, in every possible way, to all those of Europe: some are found almost everywhere.

In a group inhabiting Australia, the Indian Archipelago, and slopes of the Asiatic mountains, the dorsal plumage is mottled at all ages; a character peculiar to the nestling dress of the others. One species belonging to it (*T. Whitii*, Eyton), the largest of all the Thrushes, resembles the Missel Thrush in its form and proportions, and occasionally strays to the west of Europe, having been met with even in Britain: it is common on the southern slopes of the Himmalayas. Another (*T. varius*, Horsf.) indigenous to Java, conducts to the *Ianthocinclæ*, not only by this style of marking, but by its soft puffy plumage, short and rounded wings, and large bill and feet.

Other Thrushes, peculiar to America, and breeding in the northern division of that continent, are solitary in habit, and pass insensibly into the Nightingales; successively diminishing in size; having the bill gradually weaker and tarsi more elongated; assuming even the russet tint and rufous tail of those birds, gradually losing the breast-spots, &c. Such are *T. mustelinus*, Gm., which differs little from the true Thrushes, *T. solitarius*, *Wilsonii*, and *minor*, which last is but arbitrarily separable from the European Nightingales.

A group now generally distinguished is that of

THE MOCKERS (*Mimus*, Boié; *Orpheus*, Swains.)—

Wherein the form is much more elongated, the wings shorter, and tail in particular longer, and the upper mandible more curved.

The Mocking-bird of North America (*Turdus polyglottus*, Lin.).—One of the finest of song-birds, and remarkable for its great facility of imitating almost any sound.

There are several others, all of them peculiar to America.

The Thrushes form a great centre of radiation, which ramifies in every direction, and graduates till the norma.

generic features disappear. We have already seen them pass through *Petrocincla*, into the Chats and Wheatears, to which should be added the Robins, Redstarts, Phænicorns, &c.; through *T. varius*, into the *Ianthocinclæ*, Gould, an eastern group, with large bill and feet, very soft plumage, and short wings, the species of which inhabit shrubberies, and find their food chiefly on the ground, never flying to any distance; through certain North American species into the Nightingales; and the passage into various other received genera is equally gradual: in a word, these latter are merely ramifications of *Turdus*, different as some of them appear in extreme cases. Thus *Cinclosoma*, Vigors, conducts from the Fieldfare to the subdivision *Accentor*; the Dippers and Ant-catchers to the Wrens and Tree-creepers, &c. &c.]

Some of these birds appear to approximate the Shrikes in their habits, although there is nothing in the form of the beak to distinguish them from other Thrushes.

There are even no available characters by which to distinguish certain African species, which live in numerous bustling troops, like Starlings, pursue insects, and commit great havoc in gardens.

Several of them are remarkable for the glossy tints of their plumage, which are of a browned steel-colour, (as *T. auratus* and *T. nitens*, Tem.); and one of the former for its cuneated tail, which is a third longer than the body (*T. æneus*, Tem.) [The straightness of the wing indicates these birds to belong rather to the Starling group, as does also their brown and spotless nestling plumage, the wing primaries of which are shed at the first moult, which is not the case in any of the Thrush tribe. Their habits, as already mentioned, are strictly those of the Starlings.]

We conceive it proper to approximate also the New Guinea Thrush, with a tail three times longer than the body, and a double crest on the head, which has been considered a Bird of Paradise (*Paradisæa gularis*, Latham, and *P. nigra*, Gm.), but only on account of the incomparable magnificence of its plumage. M. Vieillot applies to it the generic name *Astrapia*.

Other Thrushes with brilliantly shining plumage, the occipital feathers of which are pointed as in the Starlings, compose the *Lamprotornis* of Temminck. [These also strictly pertain to the natural family of Starlings.] We should distinguish the *L. erythrophrys*, on account of its bright red eyebrows, formed of cartilaginous feathers.

Some Thrushes have the bill so slender, that it approximates that of the Wheatears (the *Ixos* of Temminck). [These birds are mostly crested, and have bright red feathers under the tail, which generally intimates that that appendage is carried erect. They rank among the very finest of singing birds, and the celebrated *Buhl-buhl* of the Oriental poets is one of them: all are peculiar to the eastern hemisphere, and they are closely related to the Philedons, into which they pass by insensible gradations.]

Others have a slender bill, but straight and strong, and in the greater number of them the tail is excessively forked. They are the Ænicures (*Ænicura*, Tem.), [a group having much the appearance, at first sight, of the Pied Wagtails, and resembling them in habit, but which are essentially modified Thrushes, and not distantly removed from the Wheatears].

Others, again, [closely allied to the last,] are distinguished by having legs so long, that they have the general appearance of *Waders*. They constitute the *Grallina* of Vieillot, or *Tanypus* of Oppel.

THE CRINONS (*Criniger*, Tem.)—

Are Thrushes with strong setæ at the gape, and which have sometimes bristly feathers on the neck.

Such is *Cr. barbatus*, Tem. (Col. 88).

THE ANTCATCHERS (*Myothera*, Illig.)—

Are known by their lengthened limbs and short tail. They subsist on insects, and principally Ants: inhabit both continents.

Those of the eastern hemisphere, however, are remarkable for their brilliant colours. They are

THE BREVES of Buffon (*Pitta*, Vieillot),—

[The plumage of which recals to mind that of the Halcyons and Kingfishers, the latter of which they further resemble in their flight, as do also the Dippers and Wrens, and they similarly frequent streams and brooks, like the Dipper of Europe.]

Such are *Corvus brachyurus*, Gm., and several other beautiful species, to which we add the *Turdus cyanurus*, Latham, or *Cornus cyanurus*, Shaw, which only differs in the tail, which is rather more pointed. [There are indeed two natural subdivisions, distinguished apart by the form and structure of the tail].

The *Pitta thoracina*, Tem., of which MM. Vigors and Horsfield make their genus *Thimalia*, is but little removed from *P. cyanura*, Vieillot, if we except its sombre hues and its beak, which latter diminishes more regularly in front, and thereby approaches the Tanagers.

Those of the New Continent, which are much more numerous, have brown tints, and vary in the length and stoutness of the bill. They obtain their living from the enormous Ant-hills which abound in the woods and deserts of South America; and the females of them are larger than the males. These birds fly but little, and have sonorous voices, even extraordinarily so in some instances. [They are essentially gigantic Wrens.]

Among those which have a thick and arched bill, may be particularized

The King of the Antcatchers (*Turdus rex*, Gm.; *Corvus grallarius*, Shaw), which is larger than the others, also the highest upon its legs, and that which has the shortest tail: at the first glance it might be taken for a wader; its size is that of a Quail, and its grey plumage is elegantly barred across. This species lives more isolated than the others. M. Vieillot has formed of it his genus *Grallaria*.

The species with a straighter, but still tolerably strong beak, approximate the Bush-Shrikes with similar bills.

Such are *Thamnophilus stellaris* and *Th. myotherinus*, Spix, with various others. The *M. leucophrys*, Tem., although from Java, seems to approach this group; as does also the *Brachypteryx montana*, Horsf., from the same country, in the length of its limbs; but its tail is longer in proportion, and beak more like that of a Wheatear.

Others have a sharp and slender bill, which, together with their barred tail, allies them to the Wrens.

Such are *Turdus bambla*, Tem., and *T. cantans*, Tem. Here should come M. Vieillot's genus *Rhamphocenes*.

We should replace among the Thrushes, however, numerous species that have been ranged with the Antcatchers. No group has been more overloaded with species that do not belong to it. At the same time, we must confess that the present is not more rigorously defined than other divisions of the *Dentirostres*.

We may approximate to the Antcatchers

THE ORTHONETS (*Orthonyx*, Tem.),—

Which have the beak of the Thrushes, but shorter and more slender; their legs are long, the claws almost straight, and the tail-feathers terminate in a stiff point, as in the Tree-creepers.

[The fact is, that the Antcatchers, Dippers, Wrens, Tree-creepers, and various other named subdivisions, are merely modifications of the same ramus of the great Thrush group, which grade insensibly into each other in every possible way.]

We should also separate from the Thrushes

THE DIPPERS (*Cinclus*, Bechstein; *Hydrobata*, Vieillot),—

Wherein the beak is compressed and straight, with both mandibles of an equal height, nearly linear, and tapering towards the point, the upper but slightly arcuated.

One inhabits Europe, the White-breasted Dipper (*Sturnus cinclus*, Lin.: *Turdus cinclus*, Lath.), which stands rather high, and has a moderately short tail, therein approximating the Antcatchers. It is [blackish] brown, with white throat and breast, and remarkable for its singular habit of immersing its whole body without swimming, but walking about [in a jerking, fluttering manner] at the bottom of streams, in search of the small animals which constitute its food. [At least two others have been ascertained, *C. Pallasii*, from Asia generally, and *C. americana*: all of them frequent mountain torrents, and our native species generally builds its domed nest in the precipice behind a water-fall, through which it plunges to and fro; its actions are very similar to those of a Wren.]

Africa, and the countries bordering on the Indian Ocean, supply a genus of Birds related to the Thrushes, which I have named

PHILEDONS (*Philedon*, Cuv., comprising *Meliphaga*, Lewin),—

The beak of which is compressed, slightly arcuated throughout its length, and emarginated towards the tip; their nostrils are larger, and covered by a cartilaginous scale, and their tongue terminated with a pencil of hairs.

The species, generally remarkable for some peculiarity of conformation, have been distributed by authors in the most various genera. [Their manners and actions, as observed in captivity, bear an exceedingly close resemblance to those of the Starlings.] Some of them have fleshy caruncles at the base of the beak: as *Certhia carunculata*, Lath., which inhabits the Friendly Isles, and is stated to be a superb songster, with various others. These constitute the *Creadion* of Vieillot, "and certain of them the *Anthochæra*, Swainson."

Others have portions of skin about the cheeks, divested of feathers, as the *Merops phrygius* of Shaw, &c.

In those even, which are every where completely feathered, some peculiar disposition of the plumage may be observed: as in the *Merops Novæ Hollandiæ* of Brown, wherein the ear-feathers become frizzled, and descend almost to the fore-part of the breast.

Others again are destitute of any singularity. "Those species in which the bill is long and slender, as *Certhia cucullata*, Vieillot, compose the *Myzomela*, Swainson."

THE MINAS (*Eulabes*, Cuv.)—

Approximate the Philedons. Their beak is nearly that of a Thrush; their nostrils round and smooth; and they are particularly distinguished by the broad strips of naked skin on each side of the occiput and below the cheek.

Linnæus confounded two species under the name of *Gracula religiosa*. That of India (*E. indicus*), is the size of a Blackbird, and glossy black, with a white spot near the base of the wing-primaries. Its feet, bill, and the naked parts of its face are yellow. The Javanese species (*E. javanus*) has a broader bill, more deeply cleft, also more hooked at the end, and without emargination: consequently, it should come after *Colaris*, Cuv. [a genus

the entire anatomy of which is widely different]; but it resembles the other in all the rest of its conformation, and particularly by its naked spaces on the sides of the head. Of all birds, this one is said to imitate most completely the language of Man.

Nothing can be more perplexing to systematists than the diversity in the form of bill observable in birds otherwise so nearly allied. [It intimates, with a variety of other circumstances, that naturalists have attached undue importance to the character thence derivable, in tracing the affinities of these animals. The fact is, that the *Passerinæ* contain two principal centres of radiation,—the genera *Turdus* and *Corvus*,—together with several of subordinate importance, each of which may exhibit modifications suited for any mode of life, as *fly-catching*, *nectar-sucking*, &c.: those species analogously modified upon different of these types, however, having no immediate physiological relationship for each other, such as is evinced by genera really connected by affinity, however differently modified, in their changes of plumage, system of coloration, eggs, &c., all of which require to be taken much more into consideration than has hitherto been the practice, if these birds are to be classified in accordance with their true natural affinities. One great help to a sound arrangement is afforded by the geographical distribution of forms; another by the nestling plumage, as stated on a former occasion; and a third, judiciously and not inconsiderately followed, by the style and character of the colouring and structure of the feathers, which are worthy of particular attention. Habit is the most deceptive guide of any, but should nevertheless be duly kept in view].

THE GRACKLES (*Graculus*, Cuv.; *Cridotheres*, Vieillot)—

Constitute another genus allied to the Thrushes [or rather to the Starlings], the species of which inhabit Africa and the countries bordering on the Indian Ocean. Their beak is compressed, very slightly arcuated and notched, its commissure forming an angle as in the Starlings. The feathers on the head are nearly always narrow, and there is a naked space round the eye. Their habits are those of the Starlings, like which they fly in large flocks, and pursue insects.

One species appears occasionally in Europe, the Rose Ouzel (*Pastor roseus*, Meyer), [which is sufficiently distinct from the true Grackles]. It is of a shining black, with the back, rump, scapulars, and under-parts, rose-coloured; the coronal feathers narrow, and lengthened into a pendent crest. This bird is of great service in warm countries, by destroying Grasshoppers.

Another species, *Paradisæus tristis*, Gm., has become celebrated for similar services rendered to the Isle of France. It is however a very general feeder, nestles in palm-trees, and is extremely docile. Its size is that of a Blackbird, and colour brown, blackish on the head; a spot near the tip of the wing, lower part of the abdomen, and tips of the lateral tail-feathers, white. There are numerous others. Linnæus and his followers brought together most discordant species under the appellation *Gracula*.

THE MANORRHINES (*Manorrhinus*, Vieillot)—

Have the beak very much compressed, only slightly arcuated, and feebly notched; the nostrils large, but in great part closed by a membrane, which leaves only a narrow slit; neck short. The frontal feathers, which are soft like those of young birds, are partly reflected over the nostrils.

M. viridis, Vieillot, Gal. 149.

THE CHOCARDS (*Pyrrhocorax*, Cuv.)—

Have the compressed, arched, and emarginated bill of the Thrushes, but their nostrils are covered by incumbent feathers, as in the Crows, from which they were long undistinguished.

We have one the size of a Daw, the Alpine Chocard (*Corvus pyrrhocorax*, Lin.), entirely black, with a yellow bill, the feet brown at first, then yellow, and finally red, which nestles in the clefts of rocks in the highest mountains, whence, in winter, it descends in great flocks into the valleys. It feeds on insects, snails, and likewise on fruit and grain, and does not reject carrion: [is simply a modified Crow, nearly allied to the Choughs].

Another, in India (*Pyr. hexanemus*, Cuv.), is distinguished by three barbless shafts, as long as the body, which grow on each side among the feathers which cover the ear.

I can find no sufficient character by which to separate from the Thrush group

THE ORIOLES (*Oriolus*, Lin.),—

Wherein the beak, otherwise resembling that of the Thrushes, is merely a little stouter, the legs also being rather shorter, and the wings proportionally longer. Linnæus, and several of his successors confounded them with the Cassicans, which they merely resemble in colour.

The European Oriole (*O. galbula*, Lin.), is somewhat larger than a Blackbird. The male is of a bright yellow, with the wings, tail, and a spot behind each eye, black, the tip of the tail yellow; but during the two first years he retains the permanent colouring of the female, wherein the yellow is replaced by olive-green, and the black by brown. This bird suspends its skilfully-constructed nest to the branches of trees, feeds on cherries and other fruit, and during spring on insects. It is timorous, remains in France only for a short time in summer, and travels in pairs, or three together. [In accordance with its migratory habits, it has longer wings than any of its numerous congeners.]

We should distinguish from among the others the *Regent Oriole* of authors (*Sericulus regens*, Lesson), the plumage of which is fine silky black, with velvety feathers of a bright orange-yellow on the head and neck, and a great spot of the same colour on each wing. [The female is brown, spotted with dull white. *Paradisæus aureus*, Shaw, should range along with it.]

THE GOULINS (*Gymnops*, Cuv.)—

Have the same strong beak as the Orioles, the nostrils rounded and scaleless, and not surrounded by any membrane, and a great part of the head naked of feathers.

The Grey Goulin (*Gracula calva*, Gm.), &c.—Some of them have prominences on the beak, as the *Corbicalao* of Vaillant (*Merops corniculatus*, Shaw): in these, "which constitute the *Tropidorynchus* of Swainson," the tongue is pencillated as in the Philedons.

THE LYRE-TAIL (*Mænura*, Shaw),—

The size of which has occasioned some authors to range it among the Poultry, pertains obviously to the order of *Passerinæ*, having the toes separated (excepting the outer and middle ones along the first phalanx), and approximating the Thrushes by the form of its beak, which is triangular at base, elongated, a little compressed, and notched towards the tip; the nostrils being large and membranous, and in part covered by reflected feathers, as in the Jays. The great tail of the male is remarkable for the three sorts of feathers which compose it; namely, the twelve ordinary, with very fine and widely separated barbs, two medial, each garnished on one side only with a vane, and two exterior, curved like the letter S, or like the frame of a lyre, the internal barbs of which, large and serrated, resemble a broad riband, whereas the external are very short, lengthening only towards the tip. The female has only twelve tail-feathers of the ordinary structure.

This singular species (*M. lyra*, Auct.) inhabits the rocky districts of New Holland; its size is somewhat less than that of a Pheasant. [It frequents the most retired parts of the country, and runs very fast upon the ground, but its cumbrous tail is said to disable it from flying in a direct line. The order of Birds to which it strictly belongs is sufficiently indicated by its being a songster. They are said to sing for a couple of hours in the morning, beginning when they quit the valleys, till they attain the summit of a hill, where they scrape together a small hillock, as they exhume the grubs on which they feed: on this they afterwards stand, with the tail spread over them; and in this situation imitate the notes of every bird within hearing, till after a while they return to the low grounds.]

THE SLENDER-BILLED PASSERINÆ (*Motacilla*, Lin.)—

Compose an excessively numerous family, characterized by the beak, which is straight, slender, and awl-shaped. When slightly depressed at the base, it approaches that of the Flycatchers; and when compressed and a little curved at the point, that of the straight-billed Shrikes. Some endeavour has been made to divide them as follows.

THE CHATS (*Saxicola*, Bechst.)—

Have the beak a little depressed and rather wide at base, which allies them to the last small tribe of Flycatchers. They are lively birds, rather high upon the legs. The European species build on or near the ground, and subsist on insects. [They grade from the Rock-thrushes (*Petrocincla*), and like them are remarkable for always perching on the summits of objects.

Three inhabit the British isles.]

The Stone Chat (*Mot. rubicola*, Lin.).—A small bird, [with a short tail; black on the upper parts and throat in summer, with a dark reddish breast, some white on the sides of the neck, wings, and tail; the female browner: in winter the black is more or less concealed by brown margins to the feathers; and the young are at first speckled with whitish. This species is resident throughout the year in Britain, and is common in furze-brakes and covertless situations. It has little song, which, as in the following, is often delivered on the wing.

The others are summer-visitants, of rare occurrence in the winter months.

The Whin Chat (*Mot. rubetra*, Lin.), resembles the last in form, and is more delicately coloured, with a conspicuous white streak over the eye, and black patch on the cheek. It also inhabits furze-brakes, and is more generally diffused in grassy places than the Stone Chat: is a monotonous songster.

The Wheatear Chat (*Mot. œnanthe*, Lin.).—Larger than the preceding, with the crupper and basal half of the tail-feathers conspicuously white, the rest of the tail, wings chiefly, and a band through the eyes, black, and the body fulvous: the female is browner, and the young spotted with whitish. This species inhabits still more open situations, as chalk-downs and ploughed fields, and particularly the sea-shore. Its flesh is often eaten.

There are numerous others].

THE ROBINS (*Sylvia*, Wolf and Meyer; *Ficedula*, Bechstein; [*Dandalus*, Boié; *Rubecula*, Brehm; *Erythacus*, Swains.])—

Have the beak merely a little narrower at the base than the preceding. They are solitary birds, which generally nestle in holes, and live on worms, insects, and berries.

The European Robin (*Mot. rubecula*, Lin.).—Olive-brown above, throat and breast orange-red, slightly bordered with ash-colour, the belly white: young mottled brown. [We have seen a very similar species, but with differently formed bill, from Trebizond; and there is another closely allied, from Japan.]

The Blue-throated Fantail (*Mot. suecica*, Lin.; [*Cyanecula suecica*, Brehm].)—Brown above, with a brilliant blue throat, in the middle of which is a rufous spot, [which disappears with age. This bird has been separated with propriety, and differs remarkably from the others in its gait, always running by alternate motion of the feet, like a Wagtail, *instead of hopping;* when running thus, it spreads out its tail from time to time like a fan. It is only an accidental visitant in Britain.

The following are referrible to the *Ruticilla*, Brehm; *Phœnicurus*, Swains.]

The White-fronted Redstart (*Mot. phœnicurus*, Lin.).—Grey above, with a black throat and white forehead, the under parts, rump, and all but the middle pair of tail-feathers, bright ferrugineous. [Female browner, with tail and rump similar to the male; young spotted. This is a common summer visitant in many parts of Britain, inhabiting the vicinity of large hollow trees, ivied ruins, dilapidated garden-walls, &c. Like most of the present group, it generally sings perched on some high pinnacle. Its note is plaintive and little varied].

The Black Redstart (*Mot. erythacus, tithys, gibralteriensis*, and *atrata*, Gm.)—[Rather larger than the preceding, with longer wings: no red underneath, and rarely any trace of white on the forehead. It is more confined to rocky places and great buildings than the other, and is very rare in the British islands, where, however, it does not appear to be migratory. The young of this species are not mottled. It is an inferior songster.

There are several others, all from the eastern hemisphere.

The *Petroica*, Swains., comprehends some nearly allied species from Australia. Others, with shorter legs, and rather stouter bills, conspicuous for the bright azure of their upper parts, compose the *Sialia* of the same systematist, and are found only in America. These and many other named subdivisions, including the Phœnicorns and Moucherolles, pass, however, in every possible way, into each other. They grade, as already noticed, from the *Petrocinclæ;* the true Robins form a closely-allied subdivision, *Geocincla* of Gould.]

THE FAUVETTES (*Curruca*, Bechst.)—

Have the bill straight, slender, and slightly compressed in front; the ridge of the upper mandible curving a little towards the tip.

The most celebrated bird of this subgenus [but which assuredly does not belong to it] is

The Nightingale (*Mot. luscinia*, Lin.), of a russet-brown above, whitish brown on the lower parts, with a rufous tint on the tail. Every one is acquainted with this songster of the night, the varied and melodious notes of which resound through the woods. It nestles upon trees, [always on or near the ground, among decayed leaves], and sings only till its young are excluded.

Fig. 87.—The Nightingale.*

There is a rather larger species in the east of Europe, with obscure spots on the breast (*Mot. philomela*, Bechst.).—[These birds have no particular affinity with the following, but are essentially small slender Thrushes, almost inseparably allied to *Turdus minor* and some others from North America. They have much longer limbs than the Fauvettes, seek their food principally on the ground, among decaying leaves, and the young are in their first plumage mottled, as in the true Thrushes, which is not the case with the following. The Common or Plain-breasted Nightingale has very much the same manners as a Robin, and is equally pugnacious: we have known it to breed in captivity with a female of that species. The Nightingales constitute the *Philomela*, Swains., *Luscinia*, Brehm.]

Other species, more particularly known as Fauvettes, have almost always an agreeable song, and sprightly habits. They are continually flitting about in pursuit of insects, nidificate in bushes, and the greater number of them frequent watery situations, among the reeds, &c. [Such as do so fall, for the most part, under the natural division *Salicaria*, and are very distinct from the others: they have a peculiar babbling song, and are exclusively insectivorous.

Some of them have proportionally large bills, and streakless plumage, dark above, paler underneath. Such are]

The Great Babbler (*Turdus arundinaceus*, Lin.; *Sylvia turdoides*, Tem.).—Rather less than a Redwing, and

* Sketched from life.

reddish-brown above, yellowish beneath, the throat white. [This species, which passes for a good songster, though extremely common on the opposite coast of Holland, has not yet been detected in the British islands. A nearly allied species (*S. olivetorum*, Strickland), which is rather smaller, is common in Syria. The rest are considerably less, and there is one of these, a miniature of *S. turdoides*, which is very common, though local, in South Britain, migrating in winter, as do all the rest: the *S. arundinacea*, Auct. They are the *Calamoherpe*, Meyer.

Other species have smaller bills, and are generally striated on the back, with longitudinal whitish streaks on the head, the *Calamodyta*, Bonap. Among them we find]

The Sedge Babbler (*Mot. salicaria*, Lin.; [*S. phragmitis*, Auct.]); distinguished by a conspicuous whitish streak over each eye. [This bird is also a common summer visitant in Britain, more generally distributed than the Reed Babbler (*S. arundinacea*); and is remarkable for the sparrow-like tone of many of its chirpings, which has induced an erroneous opinion that it is an imitator or mimic. There are several others.

Some species, not far removed from the Babblers, are remarkable for the absence of bristles at the gape (which in the latter are rather conspicuous), for their graduated tail, composed of broad, soft feathers, their delicately-formed feet, with straight claws, and particularly for the singularity of their note, which consists of a prolonged sibilant trill, somewhat resembling that of the Mole-cricket. They compose the *Locustella* of Gould, of which three species inhabit Europe. Such, in Britain, is

Ray's Locustelle (*L. Raii*, Auct.), or the *Grasshopper Warbler* of many writers, (fig. 88), the dorsal plumage of which is coloured like that of the Water Rail. It is common in many districts of this country, as a summer visitant, frequenting furze-brakes and other dense cover, where its singular voice is heard at all hours, but principally at dusk: while uttering this sound, it gapes very widely, and sometimes continues to emit it when flitting from bush to bush, or even hovering in the air. A larger species (*L. fluviatilis*), common on the reedy margins of the Danube, utters precisely the same sound. The *Sylvia certhiola*, Tem., of eastern Europe, constitutes the third.

Fig. 88.—Ray's Locustelle.

Those which inhabit sylvan districts have, in general, stouter bills, and all feed more or less upon fruit, of which some are great devourers. They are very distinct from the foregoing, and several are delicate songsters. Such, in the British isles, are

The Blackcap Fauvet (*Curruca atricapilla*, Auct.)—Olive-brown above, ash-colour on the neck and lower parts, becoming whitish on the throat and belly; a black, or, in the female and young, reddish-brown cap on the head. One of the finest of our native vocalists, remarkable for the melody of the loud clear whistle with which it terminates its lays. It inhabits gardens and the outskirts of woods, arrives early in spring, and is very frugivorous.

The Garden Fauvet (*C. hortensis*) resembles the Blackcap in form, except that it is rather shorter; its head is of the same colour with the back, and there is a little grey on the sides of the neck. This species is remarkable for the deep mellow tones of its voice, arrives late in spring, and is similar in all its habits to the preceding.

The other British species have white on the exterior tail-feathers, and pertain to a group the members of which are mostly less arboreal, frequenting low bushes.

The White-breasted Fauvet (*C. garrula*) is, however, often heard from the summits of high trees, having nearly the same habits as the Blackcap. It is smaller than the preceding, with a proportionally more slender bill; and ashy-brown above, pure grey on the head and neck, silvery white below, the feet lead-coloured. Is common in gardens, and has a low warbling song, with a loud inharmonious finish.

The Whitethroat Fauvet (*C. cinerea*), is larger and browner than the last, with some mahogany-colour on the wings; feet yellowish. This species, exceedingly common about hedges and low brake, is seldom seen upon trees, and is an inferior chattering songster, that often ascends singing to a small height in the air, with peculiar gesticulations. Lastly,

The Long-tailed Fauvette (*C. provincialis*), made into a genus *Melizophilus* by Leach, on account of its shorter wings and more graduated tail, wherein it only differs in a slight degree from some others, as *C. Sarda*, &c., is remarkable for being resident throughout the year in furze-brakes in some parts of the south of England. Its manners exactly resemble those of the Whitethroat. Colour dark ashy-brown, vinaceous-red below.

There are several continental species allied to all the above.]

Bechstein has separated from the Fauvettes

THE DUNNOCKS (*Accentor*, B.),—

The beak of which, still slender, but more exactly conical than that of other *Bec-fins* [and also rather sharply pointed], is slightly retracted at the edges. Their gizzard also is more fleshy.

The Alpine Dunnock (*Mot. alpina*, also *Sturnus alpinus* and *St. collaris*, Gm.).—An ashy-coloured bird [mixed with brown], with a white throat sprinkled with black, two ranges of white spots on the wing, and some bright rufous on the flanks. It inhabits the pastures of the high Alps, where it feeds on insects, descending however in winter into the plains to pick up grain. [A species of rare occurrence in the British islands.]

The Hedge Dunnock (*Mot. modularis*, Lin.), [currently termed the *Hedge Sparrow*.—This well-known species is resident in this country at all seasons, but the majority quit France in summer; emits a pleasing shrill song, particularly in early spring, which is accompanied by a peculiar shiver of the wings: it feeds very much on small seeds. There are a few others, of which one, *A. montinellus*, belongs to eastern Europe. The Dunnocks grade from the Thrushes through *Cinclosoma*.

The immense group of Sylvicoles (*Sylvicola*), peculiar to America, certainly appear to have some relationship with the Dunnocks, but are probably slender-billed modifications of the same great type as the Tanagers.

THE KINGLETS (*Regulus*, Cuv.)—

Have a slender bill, forming a perfect and very sharp cone, the sides of which even appear a little concave when viewed from above. They are small birds, which live among trees, and pursue Gnats.

Among European species, we have

The Golden-crowned Kinglet (*Mot. regulus*, Lin.),—which is the smallest of European birds, greenish-olive above, yellowish-white below, the head of the male marked with a brilliant golden-yellow crest, bordered with black, [which latter can open or close nearly over it: in the female the coronal feathers are pale yellow]. It constructs a globular nest on trees, with a lateral opening, suspends itself on their boughs in all positions, like a Tit, and approaches human habitations in the winter; [is very animated, and utters a shrill weak song in the breeding season].

A still smaller [or rather a somewhat larger] species has recently been distinguished, the crest of which inclines more to reddish, and which has a black streak before and behind the eye [with a white line on each side of the crest] (*Reg. ignapillus*, Naum). [This bird is of rare occurrence in the British isles, where the first is very common.

A third has still more recently been detected in Dalmatia, and since in England, with only a pale central yellow line in place of the crest, but a bright yellow streak over each eye (*R. modestus*, Gould). This species wants a remarkable character of the others, which is, that the nostrils are covered by a single feather, that grows over them.

There are several more, allied to the two first, in Asia and America.

The following, however, ranged by the author in this genus, have little to do with them. They constitute the restricted *Sylvia* of some nomenclators, *Phillopneuste*, Meyer, and are all summer visitants only in these parts].

The Song Pettychaps (*Mot. trochilus*, Lin.) (fig. 89.)—Rather larger than the Kinglets, and nearly of the same colour, but without any crest, [and also longer in its make. It is distinguished from one of the other British species by its duller tints, and a yellow tinge on the under tail-coverts, and from the other by its yellowish-brown legs. From both it differs in the pleasing melody of its song, which is extremely musical, though consisting only of a simple run of notes. This bird is extremely common throughout Europe, and we have seen a very similar species, if not actually identical, from Japan.

Fig 89.—Song Pettychaps.

The Dark-legged Pettychaps (*S. rufa*, Naum) (fig. 90), is rather smaller, half a shade darker, with shorter wings, and blackish-brown legs. Has only a monotonous cry of two notes, repeated many times successively, and occasionally alternated with a croaking sound, which is extremely peculiar. The young, after the first moult, of both this and the preceding species, are much brighter yellow than the old birds, but their colour gradually fades during the winter.

The Grove Pettychaps (*Mot. sibilatrix*, Lin.) (fig. 91.) has longer wings than either of the preceding, more vividly green plumage on the upper parts, with a much broader and clearer yellow streak over the eye, yellow cheeks and breast, and pure white belly and under tail-coverts. It arrives later than the others, and frequents trees much more exclusively, where it may be recognized by its peculiar shivering voice, during the utterance of which it shakes its wings in a remarkable manner; it also emits a very plaintive cry, which is common to both sexes.

Fig. 90.—Dark-legged Pettychaps.

These birds generally nestle on the ground, among the herbage. There are two other European species, *Sylvia icterina* and *S. Nattereri*.]

Le Grand Pouillot (*Motac. hippolais*, Lin.).—Larger than the preceding, [of the same size and shape as the Reed Babbler: it belongs, however, to a distinct group from either (the *Hippolais* of Brehm), and is a fine songster: it has never yet been detected in Britain, though common along the opposite coast].

Fig. 91.—Grove Pettichaps

THE WRENS (*Troglodytes*, Cuv.)—

Merely differ in having the beak still more slender, and a little arcuated. [They are properly an American group, of which one species only occurs in the eastern hemisphere.]

The European Wren (*Mot. troglodytes*, Lin.)—Brown and transversely striated, with rather a short tail, generally held erect. It builds a domed nest, and sings agreeably, even in the depth of winter.

[America produces numerous others, and there are even many well-marked divisions of them.] Some of the foreign species inosculate with the Antcatchers, and others with the Tree-creepers.

THE WAGTAILS (*Motacilla*, Bechst.)—

Combine a bill even more slender than that of the Fauvettes, with a long tail, which they are constantly shaking up and down, lengthened legs, and particularly elongated tertiary feathers, which extend as far as the tip of the closed wing, imparting a resemblance to the generality of waders.

THE WATER-WAGTAILS (*Motacilla*, Cuv.)—

Have a comparatively short and curved hind claw, and frequent the borders of water.

That of France (*Mot. alba* and *cinerea*, Lin.), is grey above, white below, with the occiput, throat, and breast, black. [The throat white in winter. It has not yet been registered as an inhabitant of Britain.

The common British Wagtail (*M. Yarrellii*, Gould), appears to be of rare occurrence on the Continent of Europe. It is somewhat larger, and has a black back in summer.

Another species, common in the north of Britain, visits the southern counties in winter—the Yellow-rumped Wagtail (*M. boarula*, Lin.)—It is grey above, with a very long tail, the outer feathers of which are white; under parts and rump bright citron-yellow, with a black throat in summer].

Another in the south of Europe resembles the common French Wagtail when young, but acquires a black back with age, the *M. lugubris*, Roux. [It is larger than any of the others.]

THE FIELD-WAGTAILS (*Budytes*, Cuv.)—,

With the general characters of the preceding, possess a long and almost straight hind-claw, which approximates them to the Pipits. [The tail is shorter, and style of colouring different.] They frequent pastures, and pursue insects among the cattle, [as do also the others].

The most common is the Grey-headed Field-Wagtail (*Mot. flava*, Lin.).—Bluish ash-colour on the head, olive on the back, bright yellow below, with an eye-streak and two-thirds of the lateral tail-feathers white. [It is very rare in Britain, where it is replaced by another species,

The *M. neglecta*, Gould, the head of which is yellow-olive, very bright in old males after the vernal moult, and the eye-streak intense yellow. It is much more seldom seen in watery situations than the preceding, and is rare on the Continent. The females of both are pale, or even dull white underneath, and the males in winter plumage have a reddish tinge on the lower parts, the young males not acquiring the yellow colour before the spring. Neither of them has any song, in which they differ from the Water-wagtails.

THE PIPITS (*Anthus*, Bechstein)—

Were long classed with the Larks on account of their long hind-claw, [and the resemblance of the colours, although not the texture, of their plumage], but their more slender and notched bill approximates them to the other *Bec-fins*.* [They have absolutely the same form as the Field-wagtails, from which they differ only in their colours, and their habit of singing on the wing.]

Such as have a moderately curved hind-claw retain the faculty of perching. [The others do so, only rather less habitually.]

The Tree Pipit (*A. arboreus*, Bechst.)—Streaked olive-brown above, paler underneath, with longitudinal dark spots on the breast; two pale transversal bands on each wing. [A migratory species, and very sweet songster, of common occurrence in Britain. It generally rises singing from the ground, and after attaining a certain height, sails descending to the summit of a tree; then rises from the tree, and descends singing to the ground. Its carriage, and general character, as seen alive, are very different from those of the others.]

Others have the long hind-claw of the Larks, and keep more on the ground. As

The Common Pipit (*Alauda pratensis*, Gm.)—[More slender than the preceding, and nearly of the same colour in winter, but less fulvous or olivaceous in summer. It is extremely common throughout Europe, inhabiting mountain moors, and lowland heaths and marshes, even to the sea-side. Frequently ascends singing into the air, but less musically than the preceding.

The Shore Pipit (*Anth. aquaticus*, Naum) is larger and darker-coloured, with a proportionally greater bill. This species abounds on the sea-coast, and is very rarely met with inland. Is a superior songster to the last.

The Great Pipit (*A. Richardi*, Vieillot).—An accidental straggler only in this country, but seldom met with. Is much larger than the others, and coloured like *A. pratensis*. There are several more, of which three inhabit Europe.

The Wagtails and Pipits compose a very insulated and distinct group, all the members of which are ambulatory in their mode of progression, and moult twice in the year. The young resemble or differ little from the adults, having a very dissimilar nestling dress from that of the Larks, to which they have been very generally, but erroneously, approximated].

We terminate this family of the *Dentirostres* with some birds which differ from all the foregoing, by having their two external toes connected as far as the second joint, a character wherein they resemble the family of *Syndactyli*.

THE MANAKINS (*Pipra*, Lin.)—

Have a compressed bill, higher than broad, emarginated, with great nasal fossæ. Their tail and limbs

* The author erroneously states, in the original, that the form of the wing distinguishes them from the Wagtails.—ED.

are short; and their general proportions occasioned them to be long regarded as allied to the Tits At their head, but as a separate subdivision, should be placed

THE ROCK-MANAKINS (*Rupicola*, Brisson),—

Which are large birds, and have a double vertical crest on the head, composed of feathers disposed longitudinally like a fan.

The adult males of the two species, both from America (*Pip. rupicola*, Gm., and *P. peruviana*, Lath.),—are of a delicate rich orange colour, while the young are dull brown. They live on fruits, and scratch the ground like a common Fowl, construct their nests with wood in the depths of caverns, the female laying two eggs.

THE EMERALD-MANAKINS (*Calyptomena*, Horsf.)—

Merely differ from the preceding in the head-feathers not being disposed like a fan.

There is a species, not larger than a Thrush, in the Indian Archipelago, the colour of which is intensely brilliant emerald-green.

THE TRUE MANAKINS (*Pipra*, Cuv.)—

Are diminutive birds, generally remarkable for their vivid colours. They inhabit humid forests in large troops.

[All are American, and they obviously pertain to the great Cotinga family, as do also the Rock-manakins.]

THE EURYLAIMES (*Eurylaimus*, Horsf.)—

Have feet similar to those of the Manakins and Rock-manakins; but their beak, as strong as in the Tyrants, is exceedingly wide and depressed, its base being wider even than the forehead.

These birds inhabit the Indian Archipelago, and have a black ground-colour, relieved by vivid colours; they have much the air of the Barbets, a genus of a very different order. Frequent watery situations, and feed on insects [and also berries].

THE FISSIROSTRES,—

Compose a family numerically small, but very distinct from all others in the beak, which is short, broad, horizontally depressed, slightly hooked, unemarginated, and very deeply cleft, so that the opening of the mouth is extremely wide, and suited for swallowing insects, which are sought for on the wing.

The tribe of Flycatchers is that to which they are most nearly allied, and especially the genus *Procnias*, the beak of which only differs in its emargination.

Their regimen, exclusively insectivorous [in the generality of instances], renders them eminently birds of passage, which quit Europe in winter. They separate into diurnal and nocturnal, like the Birds of Prey.

THE SWALLOWS (*Hirundo*, Lin.)—

Are diurnal species remarkable for their close plumage, the extreme length of their wings, and rapidity of flight. We distinguish among them

THE SWIFTS (*Cypselus*, Illiger),—

Which, of all birds, have proportionally the longest wings, and fly with the greatest rapidity. [The Humming-birds will bear comparison, if not the pelagic Tachypete.] Their tail is forked, [and consists of ten feathers only]; their extremely short feet have a very peculiar character, the thumb being directed forward almost as much as the other toes, and the middle and outer toes having each but three phalanges, like the inner one.

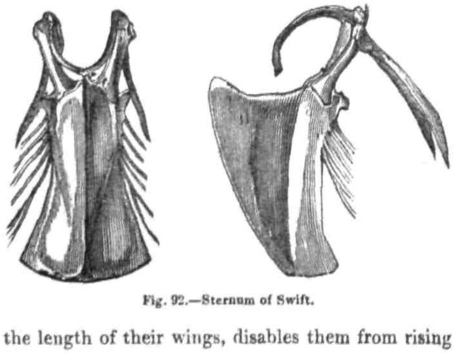

Fig. 92.—Sternum of Swift.

The shortness of the humerus, the breadth of its apophyses, the oval fourchette [devoid of any medial appendage], the sternum (fig. 92), destitute of posterior emarginations,—indicate, even in the skeleton, their adaptation for vigorous flight; while the shortness of their feet, combined with the length of their wings, disables them from rising from a plane surface. Hence they pass their time

chiefly in the air, [even copulating on the wing], and pursue insects in flocks, sometimes at a great altitude, uttering discordant screams. Thev nestle in the holes of walls and rocks, and climb perpendicular surfaces with facility.

[With this genus, we enter upon a very different type of form from any of the foregoing. The entire anatomy, if we except the trachea and toes, and the latter more than any other genus, vei closely resembles that of the Humming-birds. It is only in superficial or adaptive modifications that they accord with the Swallows. The lower larynx is furnished with only one pair of muscles, the ordinary *sterno-tracheales;* there are immense salivary glands, as in the Humming-birds, which secrete a viscid mucus, and no intestinal cœca; the clothing feathers have a considerable supplementary plume.

It is necessary to subdivide them into

THE TRUE SWIFTS (*Cypselus*, as restricted)—

Which have a forked tail, and feet as already described.

Of several species, two only inhabit Europe.]

The Common Swift (*Hirundo apus*, Lin.; *C. murarius*, Tem.)—Black, with a white throat, [and common throughout Europe in summer, making but a short stay. The young do not moult before the second autumn.]

The White-bellied Swift (*H. melba*, Lin).—Larger, and brown, with white collar and medial inferior region. [Of rare occurrence in Britain. Unlike the Swallows, these birds rear but one brood in a season. There are several more.]

Others have stiff, pointed tail-feathers, as in the Woodpeckers, and the thumb directed backward; but they pass insensibly into the preceding. They constitute the

CHÆTURA, Swainson.

There is one common in North America, the *Chimney Swallow* of Wilson; also others in the eastern hemisphere, one or more of which inhabit Australia.

THE TRUE SWALLOWS (*Hirundo*, Cuv.)—

Have the feet and sternum similar to those of ordinary *Passerinæ;* [also the complex inferior larynx as usual, small cœca to the intestine, twelve tail-feathers, &c. Their rapid flight depends entirely on external modifications, for which reason it is much less capable of protraction than in the Swifts, as is particularly shown by their weariness after performing migration, on which occasions they have been seen to alight flat upon the sea.]

Some have the feet feathered to the claws, have a slight tendency to revert the posterior toe, and a moderately forked tail; as

The Martin Swallow (*H. urbica*, Lin.).—Glossy black above, white below and on the rump. Every one is acquainted with the solid mud-built nest of this species, fixed under window-eaves, the jutting roofs of houses, &c.

Others have naked feet, and a more sharply forked tail, the exterior feathers of which are often much prolonged. As

The Chimney Swallow (*H. rustica*, Lin.).—Above [and across the breast] glossy black, the forehead and throat rufous, beneath [and a spot on each except the middle tail-feathers], white: it builds generally in chimneys.

The Bank Swallow (*H. riparia*, Lin.).—Brown above and across the breast, the throat and under-parts white. [A small tuft of down on each foot.] It burrows and forms its nest in steep banks. [There are two others in southern Europe, *H. rufula*, Tem., or *H. daurica*, Sav., and *H. rupestris*, Lin.]

Among the [very numerous] species foreign to Europe, may be noticed a very small one from the Indian Archipelago, the *H. esculenta*, Lin., which is brown above, whitish below and at the tip of its forked tail. It is celebrated for its nest, formed of a whitish gelatinous substance arranged in layers, and obtained by macerating [in the stomach] a peculiar species of fucus. The nutritious qualities attributed to these nests in China have rendered them an important article of traffic in that country.

[It is interesting to note that the Purple Swallow (*H. purpurea*) of America, which has a stouter beak than the others, feeds much on berries, at least while in its winter quarters, as observed by M. Audubon. The relation of this genus to the Phibalures has been already remarked].

THE MOTH-HUNTERS (*Caprimulgus*, Lin.)—

Have the same light, soft plumage, minutely mottled with grey and brown, that characterizes other night-birds. Their eyes are large; the beak, still more deeply cleft than in the Swallows, and [generally] armed with strong vibrissæ, is capable of engulphing the largest insects, which are retained by means of a glutinous saliva, [as in the Swifts]; the nostrils, placed at its base, are like small tubes; their wings are lengthened; the feet short, with plumed tarsi, and a membrane connecting the basal portion of the toes; the thumb itself is thus connected with the internal toe, and is directed

inward. The claw of the middle toe is commonly pectinated on its inner edge; and the outer toe has only four phalanges, a conformation extremely rare among Birds. They live solitarily [or rather permanently in pairs] and are crepuscular in their time of action, pursuing Moths and other nocturnal insects: deposit few eggs [we believe always two in number] on the bare ground, and have generally singular voices.

[The Moth-hunters bear the same relationship to the Swifts (not to the Swallows) that the Owls do to the Hawks, and have similar great cœca; also a simple vocal organ, and general anatomy very much resembling that of the Cuckoos, as will be partly seen by comparison of the figures we have given of the sternal apparatus of both. They have only ten tail-feathers; and the young are covered with down when first excluded.]

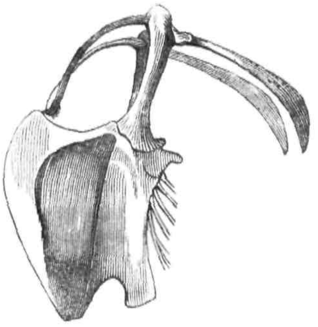

Fig. 93.—Sternum of Moth-hunter.

The common European species (*C. Europæus*, Lin.) [is remarkable for the loud sound it emits, like the burr of a spinning-wheel. Another, *C. ruficollis*, Tem., visits south-western Europe. The former is the latest to arrive in spring of all our summer visitants, rarely appearing before the end of May.

Among the foreign species, a great number have longer tarsi, adapted for running on the ground. The tail varies much in shape, and there is one, from Africa, remarkable for a feather twice the length of the body, which arises from the carpus of each wing, and is barbed only at the end; another has prodigiously developed secondaries; and there are some with an appearance of aigrettes on the head, which constitute the *Lyncornis* of Gould.

THE GUACHAROS (*Steatornis*, Humboldt)—

Have a stronger beak, and toes separate to their articulation, the thumb still directed inward.

These curious birds inhabit deep caverns in South America, subsist on berries, and the fat of the young is procured upon a large scale to be employed in cookery.

THE NYCTIBUNES (*Nyctibius*, Vieillot)—

Are also from South America, and are remarkable for having the shortest tarsi of any bird whatever: their wings are immensely long, and sides of the gape not bristled. The toes are formed for clinging to the bark of trees, as their proportions completely disqualify them from rising from a level surface.

There are several large species, which ordinarily float at a great altitude above the forests.

THE ÆGOTHELES (*Ægotheles*, Vig.)—

Have long tarsi, and toes apparently fitted for hopping from bough to bough; the wings comparatively short.

The only known species inhabits Australia, and is the *Caprimulgus Novæ Hollandiæ* of Phillips].

THE PODARGUES (*Podargus*, Cuv.)—

Have the form, colour, and habits of the Moth-hunters, but the bill is considerably more robust, and there are no membranes to the toes, nor pectination of the middle claw, [a character which is wanting in several even of the true Moth-hunters].

The species inhabit Australia and Australasia, and have some appearance of aigrettes on the head: are remarkable for the singularity of their general aspect.

The foregoing genera, commencing with the Moth-hunters, form an entirely distinct natural group, intermediate to the Swifts and Cuckoos, but passing into neither.]

The third family of the Passerines, or

THE CONIROSTRES,—

Is composed of genera that have a stout beak, more or less conical, and [generally] devoid of emargination. They subsist more exclusively on grain as the beak is stronger and thicker.

We first distinguish among them

THE LARKS (*Alauda*, Lin.)—

Which have a long and straight hind-claw, a character which however is also more or less marked in the Pipits, and in the Snowflecks, yet to be denoted. They are granivorous birds, and pulverators [of

which shake dust into their feathers instead of bathing], that run and nestle on the ground, [and ascend singing to a vast height in the air].

The greater number have a straight bill, moderately stout and pointed: as

The Sky Lark (*A. arvensis*, Lin.).—This species is known to every one for its fine and varied song, and on account of the quantities that are brought to table.

The Crested Lark (*A. cristata*, Lin.).—Similar in size and plumage, with longer coronal feathers, and of less common occurrence than the preceding. It approaches villages, [and habitually seeks its food on the high road; is remarkable for never visiting this country, though not rare on the opposite coast, even in the vicinity of Calais.]

The Wood Lark (*A. arborea*, Lin.).—Less, with a shorter tail, and the crest rather less elongated; a pale streak is continued round the occiput. [This delightful vocalist, which particularly frequents woodland hilly districts, is remarkable for the delicacy of its tones, which are peculiarly soft and plaintive.

Nine others are found in Europe, either occasionally or habitually, of which one only—the Shore Lark (*A. alpestris*), a northern species, occurs as a very rare straggler in Britain. Several have much stouter bills than the foregoing; and three or four, including *A. alpestris*, a pair of aigrettes, or pointed tufts of feathers, on the head.

The Larks, which have been much subdivided by systematists, compose a very isolated family, well characterized by their peculiar nestling plumage, which is entirely shed (including all the primaries) before the first winter. With the exception of one species, they are peculiar to the eastern hemisphere. Several have the beak comparatively stout and thick.]

THE TITS (*Parus*, Lin.)—

Have the beak slender, [rather] short, straight and conical, with little hairs at its base, and nostrils concealed by the plumage. They are very active little birds, continually flitting from spray to spray, and suspending themselves in all kinds of attitudes, rending apart the seeds on which they feed, [which they hold firm with the foot while piercing a small hole in the husk, through which they extract the kernel], devouring insects whenever they see them, and not even sparing small birds when they happen to find them sick and are able to destroy them. They store up provisions of grain; nidificate in the holes of trees, and produce more eggs than the generality of *Passerinæ*.

[These little birds are miniatures of the Jays, and equally omnivorous, subsisting on fruit in addition to the varied regimen above mentioned. As previously stated, they pertain to the same natural group as the *Falcunculus*, placed by the author among the Shrikes, and have nothing whatever to do with the present series.

Of the European species, two have shorter and thicker bills, and differ in some other minutiæ. Their plumage is prettily marked with light blue. They are the Common Blue Tit (*P. cæruleus*), so abundant in Britain, and the *P. cyaneus* of Pallas. The rest have the bill longer and more pointed. The Great Tit (*P. major*), of pleasing colours, with a black median list down the belly; the Marsh Tit (*P. palustris*), with merely a black cap and throat; the Cole Tit (*P. ater*), with a conspicuous white spot on the hind-neck, and very slender bill; and the Crested Tit (*P. cristatus*), with a pointed crest, not very dissimilar from that of a Lapwing, and which is rare in this country; inhabit the British islands, the first four being every where common.

There are a vast number of others.

THE BOTTLETIT (*Mecistura*, Leach),—

Included by the author in *Parus*, should unquestionably be separated. The beak is very short, its upper mandible curving slightly over the lower: diet exclusively insectivorous.

The Common Bottletit (*M. vulgaris; Parus caudatus*, Lin.).—A very small species, with a long graduated tail, the medial feathers of which are shorter than the next pair: the young are very differently coloured from the adults, and have the tail still longer. This curious little bird builds a most elegantly domed nest with a small side opening, upon a forked branch, and rears a numerous progeny, which follow their parents till the return of spring. The form of its feet, character of plumage, habits, all are different from those of the true *Pari*: its eyelids are naked, and of an orange-yellow colour.

Very nearly allied to the Bottletits, there is a group of small Australian birds,

THE AZURINES (*Malurus*, Vieillot),—

Which have a longer beak, resembling that of many *Bec-fins*, and the old males of which are distinguished by their intensely vivid tints of verditer and azure: they vary singularly in the number of tail-feathers, which, in one species, are reduced to four, that are extremely long and gauze-like, being the lowest number found throughout the class, where any exist at all.

The species are numerous; resemble the Bottletit in their mode of life, and manner of nidification; some of them even in the peculiar form of the tail; the medial or uropygial feathers of which are shorter than the next pair, and the exterior successively graduated. The African species sometimes referred to this genus have but little affinity to it.]

THE REEDLINGS [(*Calamophilus*, Leach)]—

Differ from the Tits in the form of their upper mandible, the tip of which curves over the lower.

[Their anatomy is strictly that of a Finch, and they are much more nearly related to the Waxbil Finches than to the Tits, with which latter they have little in common. The gullet has an extremely large dilatation or craw*, and the gizzard is remarkably muscular.

There is only one known species, the Bearded Reedling (*C. biarmicus*), an inhabitant of reedy districts, extensively diffused over Europe and Asia, and not rare in some parts of Britain. It is one of the most exquisitely beautiful of birds, although its colours are not vivid. The plumage is remarkably long and dense, the wings short, and tail long and graduated: general colour rich orange-brown, marked with black, white, and yellowish on the wings; the male distinguished by a pure ash-coloured head and neck, a long pointed tuft of intensely black feathers proceeding downward, like a moustache, on each side of the face, under tail-coverts of the same hue, the throat white, and a delicate mixture of lilac and other tints on the breast; beak and iris bright yellow, and feet (which are long and robust) black. The female has no black on the moustaches and under tail-coverts, and is every where less bright; and the young have a broad black stria along the back. Stripped of the feathers, this species appears singularly small, with disproportionally large legs: its apparent size is that of a Whitethroat.

The Bearded Reedling subsists on reed seeds during the season, and feeds very much on small shelled mollusks, which it finds among the aquatic herbage; its nest and eggs, placed in a tussock of grass, or among the sedges, a good deal resemble those of a Bunting, and the brood appears to follow the parents till the return of spring.]

THE PENDULINES [(*Ægithalus*, Vigors)]—

Have the beak more slender and pointed than in the Tits, and are celebrated for their artificially-constructed nests.

There is one in Europe (*Par. pendulinus*, Lin.).—Ash-coloured, with brown wings and tail; a black band across the forehead, which, in the male, is continued to behind the eyes. This small species, an inhabitant of the east and south of Europe, is noted for its admirable purse-like nest, composed of willow or poplar down, and lined with feathers, which it suspends to the flexile branches of aquatic trees.

THE BUNTINGS (*Emberiza*, Lin.)—

Possess an exceedingly distinct character in their short, straight, and conical beak, the upper mandible of which, narrower and more retracted at its edges than the inferior, has a hard projecting palatal tubercle. They are granivorous birds, easily ensnared.

[Of fourteen European species, three are common in Britain, a fourth along the southern coast, not far from the sea, and a fifth sometimes occurs as a very rare straggler. The form is peculiar to the eastern hemisphere, though there are some nearly allied species in North America. All are unmusical birds, that feed their young on insects, and consume much unripe corn.

Of the British species, the Corn Bunting (*E. miliaria*, Lin.) is the largest, and coloured like a Lark; beak stouter than in the others, and yellow in summer, horn-colour in winter; plumage of both sexes alike: frequents inclosures. The male Yellow Bunting (*E. citrinella*) is distinguished by its clear yellow crown and breast, and abounds everywhere upon hedges and furze-brakes. The Cirl Bunting (*E. cirlus*) is allied to the yellow species, but smaller and shorter, with a black throat; particularly frequents the summits of elms, but breeds in the hedges, and is rarely seen far inland. The Reed Bunting (*E. schœniculus*) has a black head and gorget, and white ring round the neck; the black concealed in winter (at least in the young, less so in the old birds,) by deciduous edgings to the feathers: it inhabits watery localities. Lastly, the Ortolan Bunting (*E. hortulana*) has a greenish head, with a pale yellow streak proceeding from the angle of the bill. It is very rare in this country, but abundant in many parts of the Continent, where, with some other species, it is fattened and eaten as a great delicacy.]

M. Meyer has distinguished from the Buntings

THE SNOWFLECKS (*Plectrophanes*),—

Which have a long hind-claw as in the Larks, [and lengthened wings]. Such is

The Common Snowfleck (*Emb. nivalis*, Lin.).—[Beak and upper parts deep black in summer, the rest, and the wings and tail partly, white, the feet black: in winter the black and white are more or less concealed by brown margins to the feathers, and the beak is yellow. In its nest, eggs, notes, and various other characters, this species has little relationship with the Buntings. It abounds in the most northern countries, and migrates southward in large flocks during the inclement season, when it is common in North Britain. Another species (*Pl. lapponica*) is of very rare occurrence in this island. Two others have been distinguished.]

THE FINCHES (*Fringilla*, Lin.)—

Have a conical beak, more or less stout at its base, but the commissure of which is not angular. They subsist generally on grain.

* We are aware of no instance of this dilatation existing in any of the preceding genera of *Passerinæ*

We subdivide them first into

THE WEAVERS (*Ploceus*, Cuv.),—

The beak of which is so large that some of them have been classed with the Cassicans; but the straightness of its commissure distinguishes that of the latter, and the upper mandible is moreover slightly bulging. These birds are found in both continents, and the greater number of those of the eastern hemisphere are remarkably skilful nest-builders, which interweave blades of grass, a circumstance from which they derive their name.

Such is the Philippine Weaver-bird (*Loxia Philippina*, Lin.).—Yellow, spotted with brown; throat black. Its spherical pensile nest is entered by a vertical canal, which communicates with a lateral opening of the cavity wherein the eggs are deposited.

Some of them build a vast number of contiguous nests, which form a single mass divided into numerous compartments; as

The Social Weaver-bird (*Loxia socia*, Lath.)

Among those of America, [which have been very properly separated, first into

THE BOBALINKS (*Dolychonyx*, Swainson)—

Which have stiff pointed tail-feathers], we may distinguish

The Rice-bird of the United States (*Oriolus niger* and *orizivorus*, and *Corvus surinamensis*, Gm.), innumerable flocks of which devastate the cultivated fields of several of the warmer parts of that continent.

Nomenclators have not yet succeeded in reducing to order the various black birds of America, more or less allied to the Cassicans, [near which the Bobalinks should be also placed].

THE SPARROWS (*Pyrgita*, Cuv. [*Passer*, Ray])

Have the beak rather shorter than in the preceding, conical, and merely a little bulged towards the point.

[There are five species in Europe, of which two inhabit Britain; the House Sparrow (*Fring. domestica*, Lin.), and the Tree Sparrow (*F. montana*, Lin.),—which latter has a maronne-coloured head, with the chin, and a spot on each side of the neck, black, its plumage being precisely alike in both sexes, and even the nestling young, and corresponding in its general character with that of the adult male only of the others There are several more, all peculiar to the eastern hemisphere. The beak is always black in summer, horn-colour in winter.

We have observed that the common House Sparrow, like most other birds that nestle upon buildings, (as the Starling, Jackdaw, Rook, Pigeon, Swallow, &c.), breeds in considerable numbers in the cliffs along the sea-coast, which is doubtless its aboriginal nesting-place.]

THE CHAFFINCHES (*Fringilla*, Cuv.)—

Have the beak less arcuated than in the Sparrows, stouter and more elongated than in the Linnets.

There are three in Europe. The Common or White-winged Chaffinch (*Fring. cœlebs*, Lin.); the Mountain Chaffinch, or *Brambling* (*F. montifringilla*, Lin.), [which visits Britain in winter]; and the Snow-finch (*F. nivalis*, Lin.), which nestles in the high Alps, and descends only in the depth of winter to the secondary ranges. [This bird, now generally ranking as the *Montifringilla nivalis* of Brehm, absolutely resembles the Common Snowfleck in all but the shape of its beak, which latter even becomes quite black in summer, as in that species: it affords, accordingly, one of the very numerous proofs that the value of the form of the bill, as a zoological character indicative of affinity, has been much over-estimated by systematists. In the true Chaffinches, the bill turns dark bluish in summer].

THE GOLDFINCHES (*Carduelis*, Cuv.)—

Have an exactly conical beak, without any bulging; the tip prolonged to a sharp point.

[There are two groups of them, characterized by plumage, and a slight difference of habit: in the first, the colouring is gay, the beak pale flesh-coloured in summer, and its point further attenuated. These are more particularly designated *Goldfinches*.

But two are known, the common European species (*C. elegans*), and another in the Himmalaya mountains of Asia (*C. caniceps*, Gould). The first is well known as a pleasing songster.

The rest have a shorter bill, and less elongated form; the plumage variegated black and yellow, with always a black crown. They are commonly termed *Siskins*. Of numerous species, two only inhabit Europe, and one the British Islands (*F. spinus*, Lin.).]

THE LINNETS (*Linaria*, Bechst. [*Linota*, Bonap.])

Have also an exactly conical bill, but which is less elongated.

In some, however, its tip is comparatively drawn out. [These are generally known as *Redpoles*; of which there are several species, not easy to discriminate: two occur in Britain—the Common or Small Redpole (*F. minor*, Lin.), and the Mealy or Stone Redpole (*L. canescens*, Gould), which latter is larger and stouter, with a whitish rump, that is scarcely tinged with the pink so conspicuous in the other.

The Common or Song Linnet (*Fr. cannabina*, Lin.), is remarkable for the crown and breast plumage of the male, which, in winter, is dingy reddish-brown, concealed by terminal edgings, that disappear in spring, at which season the colour changes to bright crimson: the same enhancement of tint obtains, though to a less extent, in the preceding species, the coronal and breast feathers of which are pink in winter, brightening considerably towards the breeding season. It is remarkable that none of these birds ever acquire their gay tints in captivity, although they breed freely when encaged. The same applies to several allied groups, as the Crossbills and *Erythrospizæ*, or purple Finches of the North, which latter are intermediate to the Linnets and *Corythi*.

There is a fourth British species, of inferior size to the last, with a smaller bill of a wax-yellow colour, and no pink except on the rump; the *Twite*, or Mountain Linnet (*F. montium*, Gm.), which abounds in the most northern districts of the island, and upon upland heaths, migrating southward in winter.

Various species more or less yellow are known as Serins or Canary-birds [the latter having the bill comparatively bulging.

We can only notice] the Canary, so abundantly bred in captivity (*F. canaria*, Lin.), the domesticated varieties of which are so numerous that it is difficult to assign the original colour. It hybridizes with various other Finches, producing mules that are more or less capable of propagation. [The original stock is still wild in the islands from which this species takes its name: individuals occasionally learn to pronounce words with remarkable precision and articulation.

THE WHIDAHS (*Vidua*, Cuv.)—

Are African and Indian birds, with the beak of a Linnet, sometimes a little bulged at its base, [the males of] which are distinguished by the extraordinary elongated covert feathers above the tail, [at least during the breeding season].

They grade without assignable interval into the Linnets.

THE GROSBEAKS (*Coccothraustes*, Cuv.)—

Possess an exactly conical beak, which is distinguished only by its extreme thickness.

The Haw Grosbeak (*Loxia coccothraustes*, Lin.), is one of those particularly worthy of the name, [though its beak is slight in comparison with that of some others].—Crown and back chestnut-brown, neck and rump ash-coloured, [beak dark bluish in summer, flesh-coloured in winter; the secondary feathers of the wing abruptly truncated. Its sternal apparatus is figured at p. 178, as characteristic of the whole enormous group of *Passerinæ*]. This bird inhabits wooded districts, nestles upon beech or fruit-trees, and feeds on all sorts of kernels. [Is not rare in some parts of South Britain, but in general extremely wild and shy of approach.]

The Green Grosbeak, *Green Linnet*, or *Green-finch*, (*Lox. chloris*, Lin.)—[One of the commonest of British birds: its bill turns pale flesh-colour in summer, as in the Goldfinch.

Among the very numerous groups of foreign Finches and Grosbeaks, a strongly marked subdivision is that of

THE AMADUVATS (*Amadina*, Swainson),

The beak of which is short and slightly bulging.

Such is the *Java Sparrow*, so abundantly brought alive from the Indian Archipelago, and numerous diminutive species of pleasing colours, several of which inhabit Australia.

THE WAXBILLS (*Estrilda*, Swainson)—

Are nearly allied, and also approximate the Reedlings: they have a smaller and somewhat arched bill, and long graduated tail.

Of several species, one is very commonly brought alive to this country, with delicate grey plumage transversely rayed, and a crimson streak through the eye; beneath the tail black, as in the Bearded Reedling.

They inhabit the same countries as the Amaduvats].

THE PITYLUS, Cuv.

The beak as thick as in the Grosbeaks, a little compressed, arched above, and sometimes a salient angle at the middle of the upper jaw.

[Among the various groups to which the above definition is more or less applicable, we may particularly notice one lately discovered at the Gallipago Isles,

THE GEOSPIZA, Gould,—

Wherein the beak varies singularly in shape and stoutness, notwithstanding which there is an exceedingly strong resemblance in every other character, which forbids their separation. They are chiefly ground-birds, with sombre plumage and short tails.

Mr. Gould subdivides them into *Geospiza* as restricted, with the bill of a Cardinal-finch (*Guarica*),—*Camarynchus*, with that of a *Corythus*,—*Cactornis*, wherein the beak resembles that of an *Icterus*,—and *Struthidea*, wherein it even approaches the slender bill of an *Accentor*].

THE CARDINAL-FINCHES (*Guarica*, Swainson)—

Have nearly the beak of the Grosbeaks, but slightly bulging, and are peculiar to America.

The *Virginian Nightingale*, as it is termed (*Lox. cardinalis*, Lin.), is a well-known example.

Some have the beak remarkably compressed; and a species in which this compression attains its ultimatum, constitutes

PARADOXORNIS, Gould,—

Wherein the curved ridge of the upper mandible forms an acute angle, its sides do not bulge, and the cutting edge is deeply sinuated.

The only known species (*P. flavirostris*, Gould,) inhabits the Himmalayas.

Naturalists have long separated

THE BULLFINCHES (*Pyrrhula*),—

Which have a rounded and every where bulging bill, [the tip of the upper mandible overhanging the lower one. Plumage soft and very dense].

The Common Bullfinch (*Loxia pyrrhula*, Lin.].—Ash-colour above, vivid tile-red below, with black cap, [tail, and wings partly, the rump white]. Female dull reddish-brown where the male is red. [Young destitute of the black cap. There is a race, considerably larger in all its proportions, but otherwise exactly resembling, in eastern Europe; another in Japan, differing inconsiderably in colour, but undoubtedly distinct; and a fourth on the Himmalayas (*P. erythrocephala*), more strongly characterized].

THE CROSSBILLS (*Loxia*, Brisson)—

Have a compressed beak, the mandibles of which are so strongly curved, that their tips cross each other, and not always on the same side. This extraordinary bill enables them to extract the seeds from pine-cones with astonishing facility.

[These birds present a singular modification of the same particular type to which the Siskins and Redpole Linnets appertain; than which they are merely stouter built, with the tips of the beak still more prolonged, and anomalously modified, in adaptation to peculiar habits. The species are very indeterminate, but there appear to be several of them, successively increasing in stoutness and strength of bill, but differing in no other particular; and as one of them only is distinguished by white bars on the wing, like a common Chaffinch, which character is found in individuals only of a particular size, this circumstance militates against the rest being considered *varieties* of one another.

That common in western Europe (*Lox. curvirostra*, Lin.), is of medium strength, and of late years has become considerably more abundant than formerly in the British Isles, where it was previously chiefly known as an occasional and very irregular visitant. The Parrot Crossbill (*L. pytiopsittacus*, Bechst.), is larger and stouter, with a much stronger beak, the points of which rarely pass the ridge of the opposite mandible. It is of very rare occurrence in Britain, where the white-winged species (*L. leucoptera*), which is chiefly found in America, has also occurred as a straggler. The nestling plumage of these birds corresponds with that of a Redpole, and the males afterwards assume, most irregularly, a red or buff-yellow garb, brightest on the crown, breast, and rump. Their call-note, and all their actions, strikingly recall to mind those of a Goldfinch or Redpole.]

THE PINE-FINCHES (*Corythus*, Cuv.)—

[Are simply Crossbills, devoid of the peculiar character from which those birds derive their name, with rather softer and less firm plumage, and a beak scarcely differing from that of the Bullfinches.

They have also the same irregularity of colour, and their habits are nearly similar. One species (*C. enucleator*) is common in the northern pine-forests of both continents; there is a second in northern Asia, and the *Pyrrhula longicaudata*, Tem., constitutes a third.]

THE COLIES (*Colius*, Gmelin)—

Are still very near the preceding, [a remark of the author perfectly unaccountable]. Their beak is short, thick, conical, a little compressed, the two mandibles being arcuated without either passing beyond the other*; tail-feathers [ten in number, much] graduated, and exceedingly long [and rigid]; the thumb, as in the Swifts, capable of being directed forwards like the other toes; their plumage, fine and silky, [short, dense, and smooth,] is generally of an ash-colour, [and the coronal feathers are elongated, forming an erectile pointed crest: the body feathers possess an accessory plume, and are

* The upper mandible does considerably overhang the other.—ED.

very short over the rump]. They are birds of Africa and India, which climb somewhat in the manner of Parrots, live in troops, and even breed in society, constructing numerous nests in the same bushes; lastly, they sleep suspended to a branch, with the head downward, many of them together, and subsist on fruits [the buds of trees, and tender sprouts of vegetables.

These very curious birds are closely allied by affinity to the Plantain-eaters and Touracos, and have no especial character of the *Passerinæ*. They sail from bush to bush in a long row one after another, alighting always near the ground, and clambering to the topmost twig with the assistance of the beak and long stiff tail, picking off the buds or berries; and do not pass to the next until the whole flock are ready, when they again sail in the same *regular succession. They are very mischievous in gardens in the Cape colony, devouring the young plants of* vegetables as fast as they spring up; and are there known by the term *Muys-vögel*, or "Mouse-bird:" their cry is monotonous, (having but one pair of vocal muscles,) and in the largest species closely resembles the bleating of a lamb. They constitute the ordinary food of several species of Birds of Prey, and have remarkably heavy, massive bodies, for their apparent size, the plumage lying flat and close].

Here also should be placed

THE OXPECKERS (*Buphaga*, Brisson), —

A small genus, wherein the beak, of medium length, is first cylindrical, both mandibles bulging towards the end, which terminates obtusely. They employ it to compress the skin of cattle, in order to force out the larvæ of *Œstridæ* lodged within it, upon which they feed. [The claws are accordingly extraordinarily sharp, to enable them to cling while so occupied.

Two species are now known, both from South Africa: they strictly pertain to the Starling family, and have no sort of relationship with the Honeyguides (near which some systematists place them), being true *Passerinæ*.]

THE CASSICANS (*Cassicus*, Cuv.)—

Have a large beak, exactly conical, thick at the base, and singularly sharp at the point; small round nostrils pierced at its sides; the commissure of the mandibles forming a broken line, or an angle as in the Starlings. They are American birds, with manners approaching those of our Starlings, [at least in some instances,] frequently construct their nests close together, and sometimes with much art. They subsist on insects and grain, and the numerous flocks of them commit great ravages in the cultivated districts.

We subdivide them into

THE CASSICANS, properly so called, (*Cassicus*, as restricted),

Wherein the beak mounts upon the forehead, encroaching circularly on the plumage. The largest species are included in this group.

[Some are very superior songsters, and rival the Mocking-bird in mimicry.]

THE BALTIMORES (*Icterus*, Cuv.)—

Have the beak arcuated throughout its length, and forming only a pointed notch on the forehead.

[This name is now generally applied to the *Baltimore-birds* of North America, with some proximate species from the southern continent. They do not congregate, and build an elegant pensile nest, as do also the preceding. The males are several years attaining their mature colouring.]

THE TROOPIALS (*Xanthornus*, Cuv.)

Only differ from the last in having the beak straight.

[Certain of these, the true Troopials (*Aglaius*, Swainson), have a comparatively short beak, thick at the base. Their habits are those of the Starlings, and they are exceedingly destructive in the maize plantations: they breed in small societies, sometimes on or near the ground, and where opportunities occur, in the interstices of the massive nests of the Osprey; it is said that the proportions of the sexes in these little communities are very irregular, which would intimate that they do not pair*; a circumstance the less unlikely, from their close affinity to the next, or

The Molothrahs (*Molothrus*, Swainson); of which two species are now known, both parasitic in their mode of propagation, depositing their eggs in the nests of other birds, like the Cuckoo of Europe: these certainly do not mate. They are distinguished by a still shorter bill, and differ little in their habits from the Troopials.

Several other natural subdivisions have been instituted, of which the Bobalinks, or *Rice-birds*, have been already noticed (p. 187). The Chewinks (*Pipilo*, Vieillot,) with a bulging sparrow-like bill, pertain to the same group; and there are others which approximate the Crows, as the divisions *Quiscalus*, *Scolephagus*, &c., and even the Larks, as *Sturnella*, Swainson, the members of which have the beak obtusely pointed, like the true Starlings, and are nearly related to the Bobalinks].

THE OXYRYNCHUS, Tem.,

Has a conical and very sharp bill, [not thick, and] shorter than the head.

The only known species (*Ox. flammiceps*, Tem.), has a partly red crest, like many Tyrants. [The affinities of this bird are most puzzling. It obviously belongs to the distinct division *Passerinæ*, and therefore has no particular relationship with the Woodpeckers, contiguous to which it is arranged by some. Colour, green above, whitish and spotted like a Thrush on the breast. Inhabits Brazil.]

THE PITPITS, Buff. (*Dacnis*, Cuv.)—

Represent the Baltimores on a diminutive scale, having the beak conical and sharp-pointed.

[They consist of some of the Sylvicoles, p. 191.]

THE STARLINGS (*Sturnus*, Lin.)—

Differ from the Troopials only by a compressed beak, particularly towards the point, [which is obtuse and nail-like.

[There are two in Europe, one generally diffused, and extending eastward to China,—

The Common Starling (*St. vulgaris*, Lin.).—At first dull brown, then finely glossed black, with a pale tip to each feather, imparting a pretty speckled appearance; the clothing feathers are successively more elongated and pointed for several moults, and most of their pale terminal specks finally disappear altogether, the bill also becoming rich yellow. It is easily tamed and taught to speak*, and very social in its habits, flying in large flocks: flesh bad-tasted. The other species (*St. unicolor*) has still longer pointed clothing feathers, and never any whitish spots: inhabits the south of Europe, and particularly Sardinia.]

We can perceive no characters of sufficient importance to sanction the separation, from the *Conirostres*, of the genera belonging to the family of Crows, which have precisely the same internal structure, as well as the same external organs, being distinguished only by a much greater size, which allows some of them to pursue other birds; their strong beak is often laterally compressed.

The genera are three in number, viz., the Crows, Birds of Paradise, and the Rollers [which last alone do not possess the distinctive characters of the *Passerinæ*].

THE CROWS (*Corvus*, Lin.)—

Have a strong beak, more or less compressed, and the nostrils covered with stiff incumbent bristles directed forwards. They are sagacious birds, and their sense of smelling is very acute; they have generally the habit of purloining articles that are quite useless to them, as pieces of money, &c.

We apply the name of Crow, or Raven, more particularly to certain large species, which have the stoutest beaks of any, and the ridge of the upper mandible most arcuated. Their tail is round or square.

The Raven (*C. corax*, Lin.), is the largest Passerine bird found in Europe, equalling a fowl in size. Its plumage is wholly black, the tail rounded; ridge of the upper mandible arched anteriorly. Its habits are more retiring than those of its congeners, [except where it is quite unmolested]; flight, vigorous and lofty; scents carrion at the distance of a league; and also feeds on fruit and upon small animals, even carrying off poultry; it nestles on lofty trees or in steep precipices, is easily tamed, and readily learns to speak. This bird appears to be found in all parts of the world, [a fallacious opinion, very generally received: few travellers that have seen a large black species of *Corvus* have troubled themselves to ascertain that it was the *Raven*; and collectors have generally neglected to procure a bird, which they *supposed* was not uncommon at home; the truth being, that there are as many as six or seven species confounded under the name, several of which are readily distinguishable upon actual comparison. The similitude of the common Crow and Rook of Europe should have rendered naturalists cautious in identifying the species of this genus].

The Corby Crow (*C. corone*, Lin.).—A fourth less than the Raven, with a square tail, and beak less arcuated.

The Rook (*C. frugilegus*, Lin.).—Smaller still, with a [comparatively] straight beak, more pointed than that of the last. Excepting when young, the head is bare of feathers as far back as the eyes, which the bird probably wears off in digging up the grubs on which it feeds.

These two species live in great flocks, nestling even in society; [certainly, however, not the first of them]. They devour grain as well as insects. Are found throughout Europe; remaining in the winter, however, only in the milder districts. [The Corby Crow is much more carnivorous than the Rook, and very destructive to eggs and young game: we have known it attempt to fly off with a young Turkey nearly as big as itself: it is very seldom that the Rook attacks other birds, but we have known a party of this species to destroy a brood of Missel Thrushes that had recently left the nest.]

* We have known a Starling to learn the song of the Nightingale, and warble it to perfection.

The Hooded Crow (*C. cornix*, Lin.).—Ash-coloured, with black head, tail, and wings. Is less frugivorous, and frequents the sea-shore, preying on shelled mollusks, &c.; [feeds much on carrion and garbage]. Naumann assures us that it often breeds with the black Crow, and produces fertile offspring [the truth being, we believe, that black *varieties* of the Hooded Crow now and then occur, as is indeed said to be the case by several authors.]

The Jackdaw (*C. monedula*, Lin.).—A fourth shorter than the three last, or about the size of a Pigeon, and black, with a pale gray nape; builds in steeples, old towers, &c., [and the holes of trees,] lives in flocks, and subsists on the same regimen as the others, frequently flying with them. Predatory birds have no enemy more vigilant. [These are the British species, and there are many more: one (*C. spermologus*, Vieillot) inhabits central Europe].

THE MAGPIES (*Pica*, Cuv.)—

Are less than the Crows, [and slighter built]; have also the upper mandible more arcuated than the lower, and the tail long and much graduated.

The European Magpie (*Corv. pica*, Lin.)—A very handsome bird, of a silky black, with purple, blue, and bronzed *reflections*: the belly white, and a great white patch over each wing. Its continual chattering has rendered it celebrated. It prefers the neighbourhood of human habitations, and subsists on all sorts of food, even carrying off young poultry. [Specimens from North America are undistinguishable; but there is another species in that continent, with a yellow bill, and differently bronzed tail (*P. Nuttalli*, Aud.); and we have seen a species from Norway, hitherto undescribed, much smaller in all its proportions than the common Magpie, with tail resembling that of the Yellow-billed species. We will term it *P. scandiaca*.

There are several birds nearly allied, with magnificent azure plumage; and some with shorter bills, and more strictly arboreal conformation, as the Indian *P. vagabunda*, which compose the *Dendrocitta* of Gould].

THE JAYS (*Garrulus*, Cuv.)—

Have both mandibles slightly elongated, and terminated by a sudden curve; when the tail is graduated, the bill is more lengthened; and the frontal feathers, lax and disunited, are more or less erected when the bird is excited.

The European Jay (*Corv. glanaarius*, Lin.) is a handsome bird, of a vinaceous-grey colour, with black quills and moustaches, and a beautiful mottled patch on each wing, rayed with bright blue. It subsists principally on acorns during the season. Is very imitative, and nestles in our woods, living in pairs or families. [There are two closely allied species—the Syrian Jay, distinguished by a black crown, and that of Japan, which has black cheeks; the proportions of the ornamental patch on the wing are also different. Other proximate species occur on the Himmalaya mountains.

The Jays with longer and more slender bills, and graduated tails, are all smaller, and constitute the *Cyanocorax* of Boië, in part. There are four species in North America, of which the well-known Blue Jay (*G. cristatus*) affords a familiar example. A species of this group occurs on the Himmalaya mountains of Asia, and we are disposed also to refer to it the *Pica cyanea*, Wagler, common in Spain. The Whiskey-jacks (*Perisoreus*, Bonap.) compose another small natural group, scarcely differing from the *Pari* in structure, and but little in habit: the European *Corv. infaustus*, Lin., and *C. canadensis*, Lin., of North America, belong to it.]

THE NUTCRACKERS (*Caryocatactes*, Cuv.; *Nucifraga*, Vieillot)—

Have both mandibles equally pointed, straight, and without curvature.

The European Nutcracker (*Corv. caryocatactes*, Lin.).—Brown, speckled with whitish all over the body. It nestles in the holes of trees, in dense mountain forests; climbs trees and perforates their bark, like the Woodpeckers; devours all sorts of fruit, insects, and small birds; and sometimes comes in flocks into the plains, but without regularity. Is celebrated for its confidence. [There is a larger species, closely allied, on the Himmalayas; and a third in America, without any spots, the *Corvus columbianus*, Wilson].

THE TEMIA, Vaillant (*Crypsirina*, Vieillot; *Phrenotrix*, Horsfield),—

With the front and tail of the Magpies, combines an elevated bill, and bulged upper mandible, the base of which is adorned with velvety feathers, nearly as in the Birds of Paradise.

The first-known species (*Corv. varians*, Latham), is of a bronzed green colour. These birds are found in Africa and India.

THE GLAUCOPIS, Forster,—

A similar beak and front, but two fleshy caruncles at the base of the bill.

The known species (*Gl. cinerea*, Lath.), inhabits New Holland, and is the size of a Magpie, blackish, with a graduated tail; it lives on insects and berries, seldom perches, and is esteemed good eating.

THE ROLLERS (*Coracias*, Lin.)—

Have a strong beak, compressed towards the tip, with the point of the upper mandible a little hooked; oblong nostrils placed at a slight distance from the plumage, and not covered by incumbent feathers; the feet short and stout [with their outer and middle toes free to the articulation]. They are peculiar to the eastern hemisphere, and bear some resemblance to the Jays in their manners, and in their lax frontal feathers; are vividly coloured, but in general not harmoniously.

Their anatomy offers some peculiarities which connect them with the Kingfishers and Woodpeckers; the sternum (fig. 94) is doubly emarginated, they have but one pair of laryngeal muscles, and the stomach is membranous; [they have also no cœca to the intestine. In every essential particular they thus accord with the Kingfishers and Bee-eaters, with which they form a special natural group, all the members of which take their food commonly on the wing, lay numerous polished white eggs, of an almost spherical shape, in holes of some description, collecting no nest, the young retaining their first plumage, which is little less bright than that of the adult, until the second autumn: the whole of them subsist exclusively on animal diet].

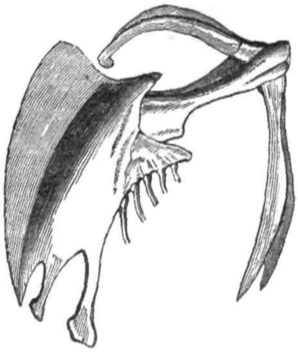

Fig. 94.—Sternum of Roller.

THE ROLLERS, properly so called,—

Have a straight beak, higher than broad, [and comparatively elongated].

There is one in Europe (*C. garrula*, Lin.).—Vivid sea-green, with reddish-fulvous back and scapularies; some pure blue at the bend of the wing; and size about equal to that of a Jay. It is a very wild bird, though social with its own kind; noisy; which nestles in the holes of trees in the forests, and leaves at the approach of winter. It feeds on worms, insects, and small Frogs. Some have the exterior tail-feathers elongated, [as in the common Swallow; and there is one species, inhabiting South Africa, which is stated to perch and watch for prey on the horn of the Rhinoceros, giving notice to that animal of the approach of the hunter].

THE ROLLES (*Colaris*, Cuv., *Eurystomus*, Vieillot),

Differ from the preceding by having a shorter and more arcuated bill, and particularly by its being widened at the base, which is broader than high.

[The species are less numerous; and there is one inhabiting Australia.]

THE BIRDS-OF-PARADISE (*Paradisæa*, Lin.),

Have a straight, compressed, stout, and unemarginated beak, with covered nostrils, as in the Crows; but the influence of the climate they inhabit, which extends to birds of several other genera [so far as the beak is concerned], imparts a velvety texture, and frequently also a metallic gloss, to those feathers which overlie the nostrils, while the plumage of various other parts acquires a singular developement. These birds are indigenous to New Guinea and the neighbouring islands. From the mode in which the specimens brought to Europe are prepared by the savages of those countries, it was formerly thought that they were quite destitute of limbs, and supported themselves entirely by their airy plumes. It is said that they live on fruits, and are particularly fond of aromatics. [They also subsist largely upon insects.]

Some of them have thinly-barbed feathers on the flanks, [or rather shoulder-tufts, which cover the closed wing,] inordinately prolonged, so as to form immense tufts, that extend far backward beyond the body; there are also two [generally] barbless filaments [the uropygials] attached to the rump, which are even more elongated than the airy lateral plumes. Such are

The Emerald Bird-of-Paradise (*P. apoda*, Lin.), which is the most anciently known species; and the Red (*P. rubra*, Vaillant). These compose the *Samalia* of Vieillot. [They are large birds, much more so than the contracted skins brought to Europe, which are evidently shrunk by the application of great heat, would lead to suppose: it is only in such specimens that the wings and legs appear disproportionately large.]

Others have the same long filaments, but their lateral tufts, though still elongated, do not extend past the tail. As

The King Bird-of-Paradise (*P. regia*, *Cincinnurus regius*, Vieillot), and the Magnificent B. (*P. magnifica*, Sonnerat), [which are very distinct, generically, from the preceding].

Some have the thinly-webbed feathers on the flanks, but they are short, and the filaments on the rump are wanting, as

The Six-stemmed B. (*P. aurea*, Gm.; *P. sexsetacea*, Shaw), with a golden-green spot on the throat, and three long filaments proceeding from each ear, which are terminated by a small disk of barbs of the same colour. It constitutes the *Parotia* of Vieillot.

Lastly, there are some with neither elongated filaments nor lateral tufts (the *Lophorina*, Vieillot), as

The Superb B. (*P. superba*, Sonnerat), and the Golden B. (*P. aurea*, Shaw; *Oriolus aureus*, Gmelin), [which last is congenerous with the Australian Regent-bird, and therefore a *Sericulus*.]

The fourth family of the *Passerinæ*, or that of

THE TENUIROSTRES,—

Comprehends the remainder of this first division; the Birds composing it being distinguished by a slender, elongated, sometimes straight and sometimes curved bill, devoid of emargination. They bear the same relation to the *Conirostres* which the *Bec-fins* do to the other *Dentirostres*.

THE NUTHATCHES (*Sitta*, Lin.),—

Have a straight, prismatic, pointed beak, compressed towards the tip, which they employ like the Woodpeckers to perforate the bark of trees, [and particularly to scale it off], to get at their insect-food; and although they climb in every direction, they have only one toe directed backward, which is certainly very strong. Their tail is of no use in supporting them, as in the Woodpeckers and Tree-creepers. [These birds also feed largely on various seeds, and are celebrated for the instinct of fixing a nut in a chink, while they pierce it with the bill, swinging the whole body as upon a pivot, to give effect to each stroke. They lay up stores of food, like the Tits.

Of several species, three inhabit Europe, and one the British Isles, which is not uncommon (*S. europæa*, Lin.).—Ash-grey above, yellowish beneath, with dark rufous flanks and under tail-coverts, the latter spotted with white; a black streak through the eye, and round white spots on the tail-feathers; size, that of a Robin. Its note is remarkably loud, and disposition fearless.]

THE XENOPS, Illiger,—

Have merely the beak rather more compressed, and its inferior ridge more convex.

THE ANABATES, Temminck,—

Have, on the contrary, the superior ridge a little convex, almost like the beak of a Thrush, without emargination. The tail is long and wedge-shaped, and occasionally worn, which intimates that it is employed for sustension. In

THE SYNALLAXIS, Vieillot,—

The beak is straight, not much elongated, slender, and pointed; the tail-feathers are generally long and sharp. There are even some of them in which the shafts of those feathers are stout, and prolonged beyond the barbs.

THE CREEPERS (*Certhia*, Lin.)—

Have an arcuated bill, but little else in common. We subdivide them first into

THE TREE-CREEPERS (*Certhia*, Cuv.),—

So named from their habit of traversing the boles of trees, in the manner of the Woodpeckers, [that is, in an ascending direction only], their tail, which terminates in similar stiff points, serving to support them.

There is one in Europe, the European Tree-creeper (*C. familiaris*, Lin.), a diminutive species, reddish-brown above, speckled with whitish, inclining to ferruginous on the rump, and pure glistening white underneath. It nestles in the holes of trees, and ascends their trunks with rapidity, searching for the insects and larvæ concealed in their chinks, and among the mosses and lichens. [Is very common throughout Britain].

America produces some true Creepers of comparatively large size, which have been termed

DENDROCOLAPTES, Hermann.

Their tail is the same, but the beak is much stronger and wider.

There is even one of them which approaches the Nuthatches in its straight and compressed beak: it might be taken for a Nuthatch with a worn tail (*Oriolus picus*, Gm. and Lath.; *Gracula picoides*, Shaw; or *Dendr. guttatus*, Spix).

The beak of another, twice as long as the head, is arched only towards the tip (*le Nasican* of Vaillant). That of a third is long, slender, and as much arcuated as in *Melithreptus*.

THE TICHODROMES (*Tichodroma*, Illiger),

Or *Wall-creepers*, do not lean upon the tail, although they creep up walls and rocks as the preceding do the trunks of trees, but they cling to them with their strong claws. Their beak is triangular and depressed at its base, very long and slender. [They moult twice in the year.]

One only is known, an inhabitant of the south of Europe (*Certhia muraria*, Lin.). It is a handsome bird of a light ash-colour, with some bright red on the wings. Throat of the male black [in summer. The affinities of this curious little bird are not obvious].

THE HONEY-SUCKERS (*Nectarinea*, Illiger)—

Neither use the tail, nor indeed climb, although their beak, of medium length, arched, pointed, and compressed, resembles that of the Tree-creepers. All of them are foreign.

The name *Guit-guit* is applied to certain small species, the males of which have vivid colours. Their tongue is bifid and filamentous. *Certhia cyanea*, Tem., and *C. cærulea*, Edwards, are American examples, to which we add some eastern species, most of which are red,—the *Cœreba*, Vieillot.

We may separate, however, the largest and least handsome of them, wherein the tongue is short and cartilaginous; as the *Merops rufus* of Spix, which constructs a nest upon shrubs, arched over like an oven, and of which M. Temminck forms his genus *Opetiorhynchus*, and M. Vieillot his *Furnarius*. The *Figulus* of Spix does not differ.

DICÆUM, Cuv.

The members of this group also do not climb, nor employ the tail: their arched and pointed beak, longer than the head, is depressed and widened at its base.

They inhabit the East Indies, are very small, and have generally some scarlet on their plumage.

In

MELITHREPTUS, Vieillot,—

The tail is also not used, and the beak is extremely elongated, and curved almost to a semicircle. They inhabit the South-sea Islands.

One species (*Certhia vestiaria*, Shaw) is covered with scarlet feathers, of which the natives of the Sandwich Isles manufacture the beautiful mantles of that colour, which are so highly prized.

THE SUN-BIRDS (*Cinnyris*, Cuv.)—

Do not lean on the tail; the edges of their long and very slender beak are finely serrated; the tongue, which is capable of protrusion, terminates in a little fork. They are small birds, the males of which have most brilliant metallic colours during the season of propagation, approaching the Humming-birds in beauty; of which, in this respect, they are the representatives in the Eastern Continent, being found principally in Africa and the Indian Archipelago. They subsist on the nectar of flowers, which they suck up; are of a lively disposition, and sing agreeably. Their beauty renders them a great ornament in our cabinets; but the garb of the female sex, and of the male in winter, is so different that the species are not easy to characterize.

In some, the tail is even; in others, its two middle feathers are elongated in the males; and some are distinguished by a straight beak, or nearly so. [In most of the true *Cinnyrides*, the lateral tuft of feathers, so enormously developed in the Birds of Paradise, exists, of small size].

THE SPIDER-CATCHERS (*Arachnotheres*, Tem.)—

Have the same long, arcuated beak, as the Sun-birds, but stronger and not dentelated; their tongue is short and cartilaginous, and the known species inhabit the Indian Archipelago, where they live on Spiders.

After all these distinctions, there are still other birds that should be separated from the great genus *Certhia*, some of which are merely Philedons, with the characters of that genus more developed.

THE HUMMING-BIRDS (*Trochilus*, Lin.).

These diminutive birds, so celebrated for the metallic lustre of their plumage, and particularly for the scale-like feathers, brilliant as gems, which offer a peculiar structure, have a long slender beak, inclosing a tongue capable of protrusion upon the same principle as that of the Woodpeckers, and which is split, almost to its base, into two filaments, employed, as is asserted, in sucking up the nectar of flowers. They also, however, feed on small insects, for we have found their stomach filled with them. Their very small feet, great tail, excessively elongated and narrow wings, and their very large sternum (fig. 95) without posterior emargination, combine to produce a mode of flight similar to that of the Swifts, besides which the Humming-birds balance themselves in the air by a rapid motion of the wings, like many Flies. It is thus they *hum* about flowering shrubs and plants, and fly more rapidly than any other bird. Their gizzard is very small, and they have no cœca, in which they approximate the Woodpeckers. They live singly, defend their nests with courage [attacking, with their needle-like bills, the eyes of an intruder, which renders these minute creatures truly formidable], and fight with one another desperately.

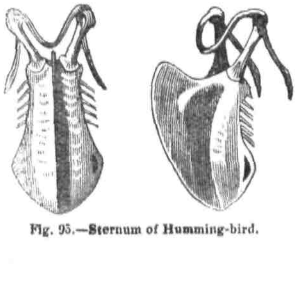

Fig. 95.—Sternum of Humming-bird.

[The whole anatomy of a Humming-bird, internal as well as external, intimates a very close affinity with the Swifts: the beak and tongue even of which, though so different at first sight, will be found on examination to differ only in not being drawn out. The Humming-birds, however, have a complicated inferior larynx, and toes with the usual number of joints: their tail-feathers, as in the Swifts, are ten in number, save in one remarkable species (thence named *T. œnicurus*), wherein they are reduced to six; the body-feathers have an accessory plume, &c. The beak varies exceedingly, in being more or less prolonged, straight, arched downward, or even recurved, like that of an Avocet, two species exhibiting which structure are now known: those which have straight beaks feed chiefly on minute insects, and have often the tip of the tongue furnished with retroflected lateral spines, precisely as in the Woodpeckers; while in the majority with curved bills, the upper mandible shuts over and incloses the lower, forming a tube and admirable sucking instrument, adapted for drawing up the nectar of flowers between the tongue and palate: the tail assumes every form in different species, and some have the shafts of the alar quills extraordinarily thickened; many have ornamental tufts of feathers, most variously disposed; and in short, the greatest variety of modifications are observable of the one general type, (which is not *passerine*,) though it is difficult or even impossible to institute satisfactory subdivisions.

Not less than a hundred and seventy species are now known, and others are constantly being discovered. All are from America, and, with few exceptions, from the southern division of that continent. The smallest of them, when plucked, are less than a large Bumble Bee; and one only, that is much larger than any others as yet known, (*T. gigas*, Auct.), nearly equals the common Swift in size: this bird is also one of the dullest-coloured, and its general resemblance to the Swifts is very manifest. Many, like the Swifts, employ a *secreted* mucus* in the construction of their nest, which is mostly placed on a horizontal, lichened bough; and they lay two similar white eggs, of an elongated form, that produce generally male and female.]

Among

THE HOOPOES (*Upupa*, Lin.),

We first arrange

THE CHOUGHS (*Fregilus*, Cuv.),—

Wherein the nostrils are covered by feathers directed forwards, a character which has induced some authors to place them with the Crows [most unquestionably their true station], to which their habits approximate. The beak is rather longer than the head, [slender, a little arcuated, singularly brittle, and much resembles red coral].

The European or Red-legged Chough (*Corvus graculus*, Lin.).—Nearly the size of a Rook, and glossy black, with red bill and legs. Inhabits the loftiest Alps and Pyrenees, and nestles in the crevices of rocks, like the Chocard, than which it is less common, and also less gregarious. Fruit and insects are equally its food, and when it descends into the valleys, its presence is a sure forerunner of snow and bad weather. [This bird is not rare on many parts of the sea-coast of Britain, breeding in the highest cliffs, but upon none of our mountains, though occasionally on lofty buildings near the sea: parties of them are not unfrequently observed on Salisbury Plain, which is considerably inland; and their appearance is there considered an indication of stormy weather. They have all the manners, intelligence, thieving propensities, &c. of the Crows and Magpies, but invariably avoid walking upon turf; their claws are hooked and very sharp, enabling them to cling to the face of perpendicular cliffs, while they insert their lengthened slender bill into crevices, picking out minute insects, which constitute their chief food. The bill and feet of the young are coloured while in the nest, but less brightly than those of the adults. Three or four additional species are known, one from New Holland.]

THE HOOPOES, properly so called, (*Upupa*),—

Have a double range of long erectible feathers on the head, forming a splendid crest.

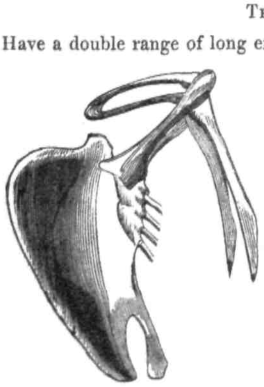

Fig. 96.—Sternum of Hoopoe.

[They possess none of the exclusive characters of the *Passerinæ*, and, upon the whole, resemble most nearly the Hornbills, from which they differ, however, in several obvious particulars. They have a wide gape, and tongue very short and heart-shaped; the mandibles much prolonged, obtusely terminated, flat, and not even grooved within; nostrils exposed, and a little removed from the base: the feet resemble those of a Lark, but are adapted for ascending steep surfaces, resting on the tarsal joint: ten tail-feathers only: a membranaceous stomach; short intestines, *probably* devoid of cœca; and a peculiar sternal apparatus (fig. 96). Flight undulatory, like that of the Woodpeckers, which they also resemble in their mode of tapping with the bill. It is altogether one of the most isolated genera of Birds.]

The European Hoopoe (*U. epops*, Lin.).—Of a rufous-chestnut colour, varied with black and white: it searches for insects in humid ground, nestles in the holes of trees or walls, and migrates southward in winter; [is singularly remarkable for its intelligence and susceptibility of attachment. There are one or two others, all peculiar to the eastern hemisphere].

* That is to say, not analogous to the macerated fucus with which the Esculent Swallow builds the Humming-birds, like the Woodpeckers, having immense salivary glands, in which the Swifts resemble them.

THE PROMEROPSES (*Promerops*, Brisson),—

Are not crested, but possess a very long tail; their tongue, furcate and extensile, enables them to suck the nectar of flowers, like the Humming-birds and Sun-birds.

[There are many species, found only in the warm regions of the eastern hemisphere.]

THE EPIMACHUS, Cuv.,—

Consists of Birds, which, with the beak of the Hoopoes and Promeropses, combine velvety or scale-like feathers, which partly cover the nostrils, as in the Birds-of-Paradise; they inhabit also the same countries, and have equally gorgeous plumage. The males have even tufts of lengthened feathers, more or less produced, upon the flanks.

The Superb Epimachus (*Upupa magna*, Lin.).—Black, with a graduated tail, three times longer than the body; the feathers on the flanks elongated, turned up, and frizzled, with the edges of a burnished steel-blue; and most magnificent coloured glosses on the plumage generally.

Naturalists have distinguished the square-tailed species, or

THE PTILORIS, Swainson,—

Such as the Twelve-wired Epimachus (*Ep. albus; Paradisæa alba*, Blum.), which was long ranged among the Birds-of-Paradise, on account of the long bunches of white plumes which decorate its flanks, the stems of them being prolonged into six barbless filaments on each side. The body is usually violet-black, and the feathers on the bottom of the breast have an edging or border of emerald green. *Ep. magnificus*, Cuv., and *Ep. regius*, Lesson, are two other superb species of this subdivision.

The second and smaller principal division of the *Passerinæ* consists of Birds wherein the outer toe is nearly as long as the middle one, and connected to it as far as the second joint. We make but one group of them, that of

THE SYNDACTYLI,

Long since divided into five genera, which we retain. [None of them are modified upon the distinct type of the *Passerinæ*.]

THE BEE-EATERS (*Merops*, Lin.)—

Have a lengthened beak, triangular at its base, slightly arcuated, and sharp-pointed. Their sternum (fig. 97) is doubly emarginated behind: [they have a membranaceous stomach, and no cœca; a short and heart-shaped tongue, and very thick skin.] Their long and pointed wings, and short feet, render their flight similar to that of a Swallow. They pursue insects in flocks, and particularly Bees and Wasps, by which it is remarkable that they are never stung [seizing the insect and at once crushing it by the snap of their powerfully compressive beak: are peculiar to the eastern hemisphere, and nearly allied to the Kingfishers and Rollers.

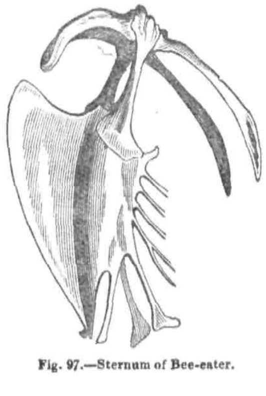

Fig. 97.—Sternum of Bee-eater.

These birds have brilliant plumage, and tail variously shaped, but generally with the uropygial feathers elongated: they excavate deep holes in banks, like the Kingfishers, and lay similar spherical polished white eggs, six or eight in number; the young retaining their first plumage till the second autumn.

Of numerous species, there is one common in the south of Europe during summer, but rare in the latitude of Britain, which it seldom visits (*M. apiaster*, Lin.): another (*M. persicus*, Pallas), visits the south-east of Europe. These birds often watch their prey from the summit of trees, to which they return after skimming about for a minute or two.

It is necessary to distinguish from them

THE NYCTIORNIS, Gould,—

Which have shorter beaks, and softer and denser plumage, loose and puffy upon the throat. Their habits are crepuscular or nocturnal, and their distribution is confined to Asia.

Three or four species are known, which are very noisy during their time of activity].

The Bee-eaters are represented in America by

THE MOTMOTS (*Prionites*, Illiger),—

Which have the same feet and port [their tarsi being however longer], but differ by a stronger bill

both mandibles of which are serrated, and by having the tongue barbed like a feather, as in the Toucans; [also short and round wings]. They are handsome birds, approaching the size of a Magpie, with lax feathers on the head, as in the Jays, [and similar loosely-webbed plumage generally,] a long graduated tail, the two middle feathers of which are stripped of their barbs in the adults for a short space near the end, which occasions a particular form of tail, [this singular mutilation being performed by the birds themselves]. They fly badly, live solitarily, nestle in holes [burrowed in sand-hills], subsist on [fruit and] insects, and even prey on small birds and other animals.

[They are intermediate to the Bee-eater and Roller group, and that of the Toucans, but perfectly distinct from either: the stomach is stated by Le Vaillant to be tolerably fleshy. Six or seven species are known].

THE KINGFISHERS (*Alcedo*, Lin.)—

Have feet still shorter than in the Bee-eaters, the beak longer, straight, angular, and pointed; the tongue and [in some instances] the tail very short. Their sternum (fig. 98) has two posterior emarginations, as in the Rollers and Bee-eaters. They live on small fish, which they take by precipitating themselves into the water from some branch, [or arresting themselves suddenly during rapid flight, poising for an instant and then plunging], and return to their perch to gulp their prey, [which they first kill by repeatedly beating it against the bough]. Their stomach is a membranous sac, [the intestines very long and slender, and without cœca]. They nestle like the Bee-eaters in holes of banks, and are found in both continents.

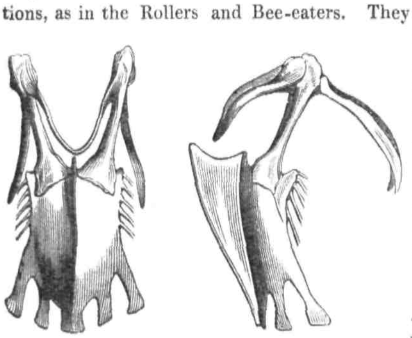

Fig. 98.—Sternum of Kingfisher.

That common throughout Europe (*A. ispida*, Lin.), is little larger than a Sparrow, of a mottled verditer green above, with a broad band of splendid ultramarine-blue along the back; the under-parts rufous. [It exemplifies the group to which *Alcedo* is now more particularly restricted, with heron-like beak, short and rounded wings, splendid colouring, and very short soft tail; the members of which, all of small size, are peculiar to the eastern hemisphere.

Others, with similar beak, have little or no vivid colouring, longer wings and tail, and some are of much larger size,—the *Ceryle* of Boiè. Species are found in both continents, and one (*A. rudis*, Lin.) inhabits the east of Europe. Of the natural group of Rollers, Bee-eaters, and Kingfishers, the present subdivision is the only one found in the New World.

Numerous other species have lighter and inflated bills, resembling those of Storks; the wings and tail as in *Ceryle*, the latter in a few instances uneven: they prey on insects, and some of the larger species on crustaceans, and are known as the Halcyons (*Halcyon*, Swainson).

Others, again, inhabit desert regions, which they traverse in search of Snakes and other reptiles: they have the general form of the Halcyons, with beak rather more approaching that of the true Kingfishers. They constitute the *Dacelo* of Leach, which comprehends the largest species of any: are peculiar to Australasia and Australia, in which latter country the most celebrated species (*D. gigantea*), which is remarkable for its loud and grating prolonged cry, is not uncommon.]

THE CEYX, Lacepede,—

Merely differs from the ordinary Kingfisher in the absence of the inner toe.

There are three species in India, [which less require to be separated than the preceding].

THE TODIES (*Todus*, Lin.)—

Are small American birds, nearly similar to the Kingfishers in their general form; and which have the same feet and elongated bill, except that the latter is horizontally flattened, and [generally] obtuse at its extremity, the tarsi being also more elevated, and the tail less shortened. [They have a small and tolerably muscular gizzard, and shorter intestines than perhaps any other bird, with great pedicillate, dilated cœca, resembling those of the Owls: the sternum is doubly emarginated, and similar to that of the Kingfisher (fig. 98), except that it is much shorter, with the crest very low: the tongue is prolonged into a very thin lamina, like that of the Jacamars.] They live on insects, and nestle in the ground, [burrowing like the Kingfishers, but laying fewer eggs, which are spotted with buff or rust-colour.

Three or four species are now known, all chiefly vivid-green, varied with other colours on the throat. They

have no affinity with various small flat-billed members of the Tyrant-flycatcher group, which have often been arranged with them by superficial writers].

We terminate the notice of this order by the most extraordinary of its genera, which bears less resemblance to the other *Syndyctali* than the latter do *inter se*, and which might very properly be ranged as a separate family.

THE HORNBILLS (*Buceros*, Lin.)—

Great birds of Africa and India, the enormous [arched and] dentelated beak of which is surmounted by a protuberance, sometimes as large as the beak itself, or which latter is at least very much inflated above, as remarkably so as in the Toucans; while their port and habits approximate them to the Crows, and their feet are similar to those of the Kingfishers and Bee-eaters. The form of the rostral excrescence varies much with age, and in very young individuals there is even no trace of it perceptible; its interior is generally cellular, [or permeated by a fragile network of osseous fibres]. The sternum has but one slight emargination on each side behind, [and is otherwise peculiar]. The tongue is short [and heart-shaped, as in the Hoopoes, and the Roller, Bee-eater and Kingfisher group], and deep in the throat. [The stomach moderately muscular, and intestines rather short and without cœca: they have only ten tail-feathers (as in the Hoopoes), and body-plumage short upon the rump, and everywhere destitute of the supplementary plume to the feathers: the eyelids are fringed with stout lashes, as if to guard the eyes from falling particles of dust disengaged by the rostral protuberance, however that may be employed, which is unknown.* The bones are more completely permeated by air than in any other genus, the ambient fluid penetrating even the phalanges of the toes]. They subsist on all sorts of food, devouring tender fruits, chasing Mice, small birds and reptiles, without disdaining carrion; [and breed in the hollows of decayed trees, producing four rounded white eggs.

The species are very numerous, and one alone is distinguished from the rest by having a solid bony protuberance to the bill, of medium size. The flight of these birds is sailing, and resembles that of a Crow; and on the ground they advance by a leaping mode of progression, assisted by the wings: the larger species are extremely shy and difficult of approach, and they always perch on the decayed branches of lofty trees, where their vision can command a wide range. It requires to be confirmed that any of them feed on vegetable diet when in a state of nature.]

THE THIRD ORDER OF BIRDS,—

THE CLIMBERS,† [ZYGODACTYLI, Tem.]—

Consists of species wherein the outer toe is directed backward like the thumb [except in the Trogons, where the first and second toes are opposed to the third and fourth], from which results a more efficient grasp, which certain of the genera avail themselves of to cling to the trunks of trees, and so climb up them. The name of CLIMBERS (*Scansores*) has, therefore, been appropriated to this division, although it does not rigorously apply to all its component members, and there are also several birds that climb equally well, the toes of which are disposed in the ordinary manner, as the Tree-creepers and the Nuthatches.

The Birds of this order nestle generally in the holes of decayed trees; their flight is [ordinarily] but moderate; their nourishment, as in the *Passerinæ*, consists of insects and fruits, according as the beak is more or less robust; and certain of them, as the Woodpeckers, are provided with special means of obtaining it.

In the greater number of genera, the sternum is doubly emarginated at its posterior edge; but in the Parrots [which have no sort of affinity with any of the rest] there is merely a hole or foramen, and often not even this.

THE JACAMARS (*Galbula*, Brisson)—

Hold a near relationship with the Kingfishers by their lengthened beak, which is pointed, with a sharp upper ridge, and by their short feet, the two front toes of which are connected to the second joint;

* The Ani (*Crotophaga*) which have a very similar elevation of the beak to that of several of the smaller Hornbills have also the eyes guarded by lashes.

† More properly speaking, yoke-footed birds, as the greater number of them do not climb.—ED.

these, however, not being the corresponding toes to those which are joined together in the Kingfishers. [The sternal apparatus (fig. 99) is most nearly related to that of the Bee-eaters, but much shorter, with a lower medial ridge; the Jacamars thus holding the same analogy with those birds which the Todies do to the Kingfishers; and like the Todies, they have also a considerably lengthened, exceedingly thin, lamina-like tongue, a small and rather muscular gizzard, short intestines, and similar great cœca: both genera are very slightly made, have exceedingly thin skins, and soft puffy plumage (the character of the feathers being however different); the nostrils are a little removed from the base of the bill, and quite exposed; the gape is furnished with vibrissæ; and they subsist by taking insects in the manner of a Flycatcher]. Their feathers have always a brilliant metallic shine. They live solitarily in humid woods, and nestle on low branches, [or, more probably, as Le Vaillant was informed, in the holes of trees, laying blue eggs].

Fig. 99.—Sternum of Jacamar.

The American species have a long beak, which is quite straight [the diagnosis of the restricted Galbula.] These are much more numerous than the following.

Others, from the Indian Archipelago, [a mistake of Le Vaillant, all the species inhabiting America, ike the Todies,] have a shorter and more inflated beak, which is a little arched, and thus approximates that of the Bee-eaters. Their anterior toes are more separated. They constitute the *Jacamerops* of Le Vaillant, and that naturalist even figures one species devoid of the ridge to the upper mandible.

Lastly, there is one in Brazil, which has only three toes.

THE WOODPECKERS (*Picus*, Lin.)—

Are well characterized by their long, straight, and angular bill, the end of which is compressed into a wedge adapted for perforating the bark of trees; by their slender vermiform tongue, armed towards the tip with lateral retroverted spines, and which, by the action of the elastic cornua of the hyoid bone, can be thrust far out from the beak: and finally by their tail, composed of ten feathers with stiff and elastic stems, which serve them as a support in climbing, besides which the twelfth pair of tail-feathers invariably exist externally, of minute size. They are pre-eminently climbing birds, which traverse the bark of trees in every direction, [or rather, like the Tree-creepers, they are unable to proceed in a downward direction, otherwise than obliquely backward; whereas the Nuthatches and Barbets climb perpendicularly upward or downward with equal facility]; striking with the beak, and insinuating their long tongue into chinks and crevices, to draw out the larvæ of insects on which they feed, [besides which, some of them subsist largely on acorns and nuts, even upon soft fruits, and on eggs.*] The tongue, in addition to its armature, is supplied with a viscid mucus secreted by large salivary glands, [which mucus is conveyed by a double duct that opens at its tip]: it is retracted by two muscles wound like ribands round the trachea, and when thus drawn in, the horns of the *os hyoides* slide round the skull beneath the skin nearly to the base of the upper mandible, the sheath of the tongue corrugating into folds at the bottom of the throat. Their stomach is nearly membranous, [though considerably less lax than in the Cuckoos]; and they have no cœca.† Shy and wary, these birds pass the greater portion of their time solitarily, and, at the nuptial season, may often be heard summoning the female by rattling the beak against a dead branch. They nidificate once a year in the holes of trees, and both sexes incubate by turns.

Fig. 100.—Sternum of Pied Woodpecker.

[The species are extremely numerous, and generally distributed, with the exception of Australia. The great majority have crimson feathers on the head, and the largest of them have the rest of the plumage mostly pied with white. Such, in America, are the great Californian Woodpecker (*P. imperialis*, Gould,) and the Ivory-billed and Pileated Woodpeckers, wherein the actual texture of the beak closely resembles ivory; also, the Great Black Woodpecker of Europe, which is stated to have been sometimes met with in Britain.

Others, forming an extremely numerous group, the *Dendrocopus*, Swainson, differ little but in being smaller and more mottled with white. They inhabit, like the former, northern or mountain districts, feed much on nuts and acorns, and never descend to the ground. Of four in Europe, two inhabit Britain, the *Picus major* and *P. minor*, Auctorum.

Some, the *Apternus*, Swainson, are destitute of the ordinary hind-toe. There are several species, and one in northern Europe (*P. tridactylus*, Lin.)

Many of those of tropical climates have full soft crests, and generally bald necks: these constitute the *Malacolophus*, Swainson.

* AUDUBON, *Pic. erythrocephalus*.

† Prof. Owen found, in a single individual of the common Green Woodpecker, two cœca of moderate size. In many that we have examined, these appendages were invariably wanting.—ED.

Others have cylindrical or much less angular bills, and smooth firm plumage,—the *Melanerpes*, Swainson, to which the well-known Red-headed Woodpecker of North America appertains. These are the most frugivorous of any, and sometimes feed on the eggs of other birds, even entering Pigeon-houses for that purpose. Their colours are disposed in large masses.

The Green Woodpeckers, or Poppinjays, (*Gecinus*, Boié; *Chrysoptilus*, Swainson,) constitute another subdivision, remarkable for the inner emargination of the sternum being much smaller than the outer, and for barred plumage in the young, which corresponds with the adult garb of certain species with slightly arcuated bills, that compose the *Colaptes*, Swainson: these two subdivisions are closely allied together, and the members of them frequently descend to feed at ant-hills, being exclusively insectivorous: there are two in Europe of the first, of which the common Green Woodpecker of Britain may be cited as an example, as the equally common Golden-winged Woodpecker of North America may be of the other. The species of both are remarkable for contorting the neck in the same manner as the Wrynecks.

Some additional subdivisions have been proposed, which are less admissible.]

THE WRYNECKS (*Yunx*, Lin.)—

Have the tongue extensible, as in the Woodpeckers, and by the same mechanism, but without spines; their straight and pointed bill is somewhat rounder and less angular, and the tail is similarly composed, but broad, soft, and flexible [at the extremity, notwithstanding which the shafts are tolerably firm, and the bird leans on them when clinging]. They live pretty much as the Woodpeckers, except that they seldom climb, [and feed principally on Ants. Their flight is swift, and not undulating as in the Woodpeckers.

Two species only are known, one common in Europe as a summer visitant, appearing in Britain rather plentifully. Its size is that of a Lark, and colour elegantly pencilled brown and ash, resembling a lichened branch. This bird arrives early in the spring, and is well known for its frequently reiterated cry, which resembles that of the smaller Falcons; it often repeats this note, holding on to a perpendicular twig. Instinctively trusting to the close resemblance of its tints to the situations on which it alights, it will lie close, and sometimes even suffer itself to be taken by the hand; or on such occasions will twirl its neck in the most extraordinary manner, rolling the eyes, and erecting the feathers on the crown and throat, occasionally raising the tail, and performing the most ludicrous movements; then, taking advantage of the surprise of the spectator, will suddenly dart off like an arrow. It breeds in the holes of trees, and lays several polished white eggs, resembling those of a Woodpecker.]

THE PICULETS (*Picumnus*, Tem.)—

Scarcely differ from the Wrynecks, except by a very short tail, [which is soft, and held elevated, like that of a Wren. Their beak and tongue are rather, however, those of a true Woodpecker, which they exactly resemble in their whole anatomy]. They are very small birds, and there is even one of them which is destitute of the small hind-toe.

THE CUCKOOS (*Cuculus*, Lin.)—

Have the beak of mean length, rather deeply cleft, compressed, and slightly arcuated; the tail long, [with ten feathers only]. They subsist on insects [and fruits], and are mostly migratory. [Have a lax stomach, cœca like those of the Owls, and no gall-bladder]. We subdivide this numerous group as follows.

THE TRUE CUCKOOS (*Cuculus*, Cuv.)—

Have the beak of medium strength, and short [partly feathered] tarsi. They are celebrated for the singular habit of depositing their eggs in the nests of insectivorous [as well as granivorous] birds; and, what is not less extraordinary, the foster-parents, often of species much inferior in size, bestow as much care on the young Cuckoo as upon their own proper nestlings, even although the deposition of the strange egg is preceded [or rather, (as we have ascertained,) succeeded, which is still more curious,] by the destruction of whatever others may have been in the nest: [or, if other eggs are subsequently laid, and hatched with the young Cuckoo, the latter is endowed with the astonishing instinct, about the eighth day, of ejecting its helpless companions by insinuating itself under them, and then by a jerk casting them successively over the rim of the nest]. The cause of this phenomenon, unique [so far as is known, with the exception of the Molothrahs (p. 190),] in the history of Birds, is yet unknown, [but appears, we conceive, to be immediately connected with the structure of the reproductive organs; and to be necessitated by the fact of the female Cuckoo requiring several days to intervene between the deposition of each successive egg, five or six in number, for which reason she could not well incubate her own: certain it is, however, that although a great proportion of the young Cuckoos are not hatched till after their parents have migrated southward, the female has been often seen to loiter about in the vicinity of her offspring, which she has been known to entice away when it

took flight]. Herissant attributed the phenomenon to the position of the gizzard, which in fact is placed further backward in the abdomen, and is less protected by the sternum (fig. 101) than that of other birds [in general, but not of the Moth-hunters, which the Cuckoos closely resemble in their internal anatomy, and particularly in the singularly diminutive size of the brain: the young are exceedingly slow in learning to take their own food, and are fed by their foster parents till they have nearly attained the full growth of their feathers.

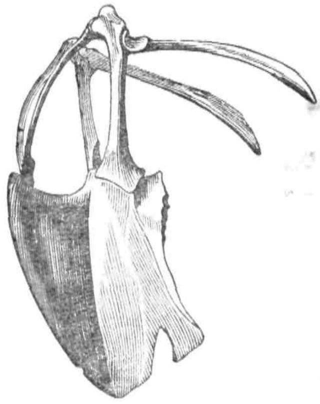

Fig. 101.—Sternum of Cuckoo.

Of various species, all peculiar to the eastern hemisphere,] there is one in Europe,

The Common Cuckoo (*C. canorus*, Lin.)—Of an ash-grey colour, the belly whitish, rayed with dusky black across, and tail-feathers laterally spotted with white: the young barred all over with rufous. [It feeds principally on caterpillars, and is sometimes seen to hawk for insects on the wing, also devours cherries and the smaller fruits. Is well known for its cry, which is common to both sexes, and is sometimes uttered on the wing; as is also another particularly melodious sound, which it generally emits as it takes flight; it often congregates many together on the same tree, attracted by each others' notes; but never flies in society, except when migrating. It does not pair; is particularly shy and retiring in disposition, and is often buffeted by the small birds on whose domain it encroaches.]

Africa [and the islands of the Indian Ocean] produce several small species, the plumage of which is more or less gilded, [or brilliant emerald-green, bronzed, or purple]. Their beak is rather more depressed than in the preceding, [and they compose the *Chalcites*, Swainson, which, however, are scarcely separable either from structure or habit].

A crested, spotted species is occasionally found in southern Europe, the cry of which is more sonorous (*C. glandarius*, Edwards). [This, with various others from Africa, pertains to the distinct group *Oxylophus* of Swainson, which, with the following, has longer and naked tarsi.]

Others inhabit America [all of which build nests and rear their offspring, constituting the *Erythrophrys*, Swainson: these are well known to feed much on the eggs of other birds, which it is generally believed the true Cuckoos do also: some of them descend much on the ground, and prey on snails like a Thrush, in addition to berries and caterpillars. The young resemble the adults].

Others again, with generally spotted plumage, have the beak deep vertically.

THE COUAS (*Coccyzus*, Vieillot)—

Merely differ from the Cuckoos by their elevated tarsi. They nestle in the holes of trees, and do not entrust their eggs to the charge of strangers: this is at least true, with respect to those species of which the propagation is known.

There is one in America that requires to be distinguished,—

THE LIZARD-SEEKER (*Saurothera*, Vieillot),—

Which has a long beak, curved at the tip only, [and feet adapted for running swiftly on the ground, as is the case with the American Cuckoo tribe generally].

It is the *Cuculus vetula* of Temminck.

Le Vaillant has already separated, with good reason,

THE COUCALS (*Centropus*, Illiger),—

Birds of Africa and India, the thumb-nail of which is long and pointed as in the Larks, [and the plumage in general singularly rigid and spinous]. All the known species are natives of the eastern hemisphere, and nestle in the holes of trees, [producing white eggs. They feed chiefly on Grasshoppers, and run about with celerity among reeds and other herbage, from which they are slow to take wing: their flesh is particularly rank; and the eyelids are fringed with lashes, as in most of the Cuckoo tribe which rear their own offspring.

The species are very numerous, and grade into the true Couas and Malkohas].

The same naturalist has rightly separated

THE COUROLS (*Leptosomus*, Vieillot),—

Madagascar birds, the beak of which is thick, pointed, straight, and compressed, with the tip of the

upper mandible but slightly arcuated, and the nostrils pierced obliquely in the middle of each side of it. Their tail consists of twelve feathers; and they nestle in holes of trees like the preceding, and inhabit forests. It is said that they are principally frugivorous.

[They are closely related to the Puff-birds of America, and like them produce only two eggs, and have the first and fourth toes directed laterally, enabling them to perch lengthwise.]

THE HONEY-GUIDES (*Indicator*, Vaillant)—

Are birds of South Africa that feed on honey, and which are celebrated for guiding the natives to the nests of wild Bees, enticing them to the spot by flitting before them, and reiterating a peculiar cry; [they also, however, lead them in like manner to where a beast of prey lies concealed]. Their beak is short, high, and nearly conical, like that of a Sparrow. There are twelve tail-feathers; and the tail is at the same time wedge-shaped and a little forked. Their skin, singularly tough, protects them from the stings of Bees; which latter, however, continually tormenting them, sometimes kill them by attacking the eyes.

[These curious birds are most nearly allied to the Woodpeckers, and climb trees in the same manner, having similar feet and claws. Their colours are sombre, and, contrary to what occurs in all the Cuckoo tribe, there is a distinct accessory plume to their feathers. They lay several pure white eggs in the holes of trees, precisely like those of the Woodpeckers.]

THE BARBACOUS (*Monasa*, Vieillot)—

Have the beak conical, a little compressed, lengthened, slightly arcuated towards the tip, and armed at its base with stiff bristles or barbless plumes, which approximate them to the Barbets, [or rather to the Puff-birds, which the author ranges with the Barbets, like which they have also twelve tail-feathers, and the first and fourth toes directed laterally. The sternum resembles that of a Cuckoo, but with a small second emargination.

These birds have blackish plumage, and generally coral-red bills. Their habits are precisely the same as those of the Puff-birds, which they further resemble in laying two eggs in holes, and in being peculiar to America.]

THE MALKOHAS (*Phœnicophæus*, Vieillot)—

Have a very thick bill, round at its base, and arched towards the tip, [somewhat as in the Toucans], with a great naked space round the eyes. Some have round nostrils, placed near the base of the bill, while in others they are narrow, and situate near its edges. They are natives of Ceylon [and other warm parts of the eastern hemisphere], and live, it is said, principally on fruits.

Certain species of them should probably be distinguished, that have the beak less thick, and no bare space round the eyes.

THE RAIN-FOWL (*Scythrops*, Latham)—

Have the beak still longer and thicker than in the Malkohas, and furrowed on each side with two shallow longitudinal groves: their nostrils are round, and the space surrounding the eyes naked. The beak approaches that of the Toucans [in its superficies only], but the tongue is not ciliated as in those birds.

Only one is known, the Australian Rain-fowl (*Scr. australasia*, Shaw), a grey bird of the size of a Crow, whitish and a little barred underneath. [Its sternal apparatus and digestive organs resemble those of the European Cuckoo, as do also its system of coloration, and the structure of its feathers. Mode of propagation unknown].

THE BARBETS (*Bucco*, Lin.)—

Have a thick conical beak, bulged on the sides of its base, with five overlying bundles of stiff bristles directed forwards; one behind each nostril, another on each side of the base of the lower mandible, and the fifth placed at its symphysis. Their wings are short, and their proportions and flight rather heavy. They subsist on insects, and attack smaller birds; occasionally feeding on fruit: nestle in the holes of trees.

They require to be divided into three subgenera.

THE BARBICANS (*Pogonias*, Illiger)—

Have one or two strong denticulations on each side of the upper mandible, the ridge of which is arcuated and obtuse, [and the sides marked with transverse grooves]. Their bristles are very stout. They inhabit Africa and India, and feed more on fruit than the others.

[The species are not numerous, and are generally black variegated with crimson. The compressive force of their beak is very considerable; and they seldom climb.]

THE RESTRICTED BARBETS (*Bucco*, Cuv.)—

Have the beak simply conical, slightly compressed, with a blunt ridge, a little raised about the middle. They are found in both continents, and are generally adorned with vivid colours. At the season of propagation they are found in pairs, and in little troops [or families] during the remainder of the year.

[This and the preceding subdivision form a totally distinct group from the rest, and are most nearly related to the Woodpeckers: the tongue, however, is of the ordinary structure, and they have but ten tail-feathers, which are not rigid. Their feet also are adapted for descending the trunks of trees, like a Nuthatch, and not merely for ascending them, as in the Woodpeckers and Tree-creepers; having the claw of the reversed toe particularly hooked and sharp. The beak is especially fitted for cutting the stems of fruits, as with a pair of scissors; and they lay always four white eggs in the holes of trees, occasionally resorting to the composite nests of the social Grosbeaks. Some other divisions have been instituted among them, with propriety; and they altogether constitute a natural family, some species of which are even entirely destitute of the tufts of bristles, which latter may be traced, in various degrees of developement, in many other birds, as the Trogons, &c.]

THE PUFF-BIRDS (*Tamatia*, Cuv.)—

Have the beak rather more elongated and compressed, with the extremity of the upper mandible [generally] bent downward. Their disproportionately large head, great beak, and short tail, impart an air of stupidity, [which is less observable in the ordinary aspect of the living bird, the dense plumage of which is commonly puffed out into a round ball]. All the known species inhabit America, and subsist on insects.

[They are generally subdivided into *Tamatia* proper, the beak of which somewhat approximates that of the Bush-shrikes, and *Lypornyx*, in which it is smaller, little if at all hooked at the tip, and grading towards that of the Barbacous. Together with the latter genus, and the Courols of Madagascar, they form a distinct group, most nearly related to the Cuckoos, which they resemble anatomically; all the members of which appear to possess the habit of puffing out their feathers, and perch lengthwise, clasping the bough with their first and fourth toes, which are directed sideways and not backwards, the same as in the Touracos: they have all twelve tail-feathers, and invariably lay two eggs, in holes either of trees or banks, which probably produce male and female that associate for life, as they are constantly observed in pairs. The American species appear to differ in being exclusively insectivorous, watching for the larger insects, which they take in the manner of a Flycatcher: their manners are familiar; and the plumage of the forehead directed forwards and more or less terminating in stiff points, very rigid to the feel, which admirably defend the eyes from the fluttering of their insect-prey. The colours of all are sombre, and not gay, as in the Barbets].

THE TROGONS (*Trogon*, Lin.)—

Together with the bundles of bristles round the bill of the Barbets, have a short beak, broader than high, curved at its base, with a blunt arcuated ridge to the upper mandible. Their small feet, feathered nearly to the toes, their long and broad tail, and fine, light and dense plumage, impart a peculiar air. Some portion of their plumage has generally a brilliant metallic lustre; the rest being vividly coloured. They nestle in the holes of trees [producing two or four delicate rounded white eggs, the shell of which is particularly slight and fragile], subsist on insects, and frequent low branches in the interior of thick woods, flying only during the morning and evening.

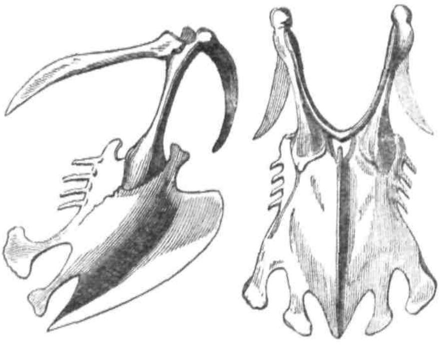

Fig. 102.—Sternum of Trogon.

[The Trogons constitute another distinct and insulated group, intermediate in some respects to the Cuckoos and Moth-hunters, both which they resemble generally in their anatomy, but are hatched naked, in which they differ from either. The sternum (fig. 102) is doubly emarginated. Their toes are remarkable for being zygodactyle on a different principle from that of any other genus; the ordinary inner toe being reversed instead of the outer one: their feathers closely resemble in structure those of the true Poultry, and are similarly elongated over the rump, where in certain species they attain an extraordinary developement in the male sex, analogous to the train of a Peacock. Like the Poultry, also, they are remarkable for the small proportional size of the head. They capture insects in the manner of a Fly-catcher, with a swift and deeply undulating flight; some of them feeding likewise upon berries. Are found in the warm regions of both continents.]

THE ANI (*Crotophaga*, Lin.) —

Are known by their thick, arcuated, and compressed beak, without denticulation, high, and surmounted

by a sharp vertical crest [like that of several of the smaller Hornbills]. They are birds of the hot and humid climates of America, with stout and elevated tarsi, a long and rounded tail [composed of only eight feathers], and black plumage. They subsist on insects and grain, fly in flocks, and several pairs lay and incubate in the same nest, which is placed on the branches of trees, and is built of a size proportionate to the number of couples which help to construct it. They are easily tamed, and even taught to speak; but their flesh is rank and disagreeable.

[The similarity of the colour and size of these birds to the *Quiscali* and *Scolephagi*, (p. 202), which inhabit the same countries, has occasioned much confusion in their history. It is the latter, and not the Ani, which are granivorous; and which also are easily tamed and taught to speak, the Ani having no accessory vocal muscles, and consequently only uttering a particular screech. The name *Crotophaga* implies that they feed on the insect parasites of cattle, like the common Starling; which is not true of the Ani, though it applies to the birds with which they have been confounded. The Ani strictly appertain to the Cuckoo group, and are remarkable for possessing eyelashes like the Coucals and Hornbills: though inhabitants of the hottest regions of America, they are remarkably solicitous for warmth, and soon perish of the least chill; hence their singular sociality even while brooding on their eggs, which are of a dark green colour. Several species are now known, and they appear to subsist exclusively on insects.]

THE TOUCANS (*Rhamphastos*, Lin.)—

Are at once recognized by the enormous size of the bill, which is nearly as large and as long as the body itself, but internally very light and cellular, [or rather permeated by a fragile network of osseous fibres], having its edges dentated, and both mandibles arched towards the tip; the tongue is narrow and elongated, and laterally barbed like a feather. They are peculiar to the warm regions of America, where they live in small troops, [different species of them commonly associating in the same flock], and subsist on fruit and insects, and during the nesting season on the eggs and young of other birds. The structure of the bill necessitates them to throw each morsel of food into the air, and catch it in the throat; [a habit practised by many other birds in which the tongue is either unusually short, or of a form unfit to assist in deglutition]. Their feet are short [not particularly so]; their wings but moderate, and tail rather lengthened, [and commonly held erect; it consists of ten feathers]. They nestle in the trunks of trees [producing, in every known instance, two delicately white eggs, of a rotund form: the young recurve their tails upon the back while in the nest.

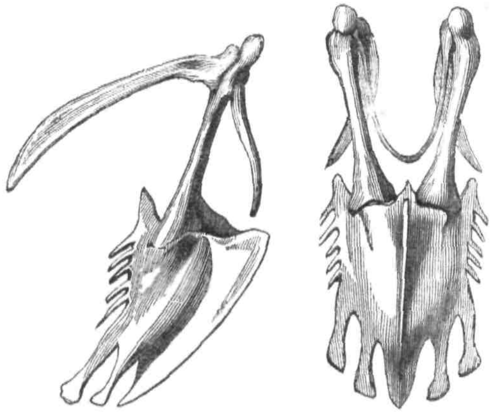

Fig. 103.—Sternum of Aricari.

These birds have a doubly emarginated sternum of peculiar form (fig. 103), a slightly muscular stomach, and short intestines without cœca: they have no gall-bladder. Their movements are light and elegant in an extreme degree, leaping from bough to bough with the most lightsome agility, so that, in the living bird, the beak has no appearance whatever of being disproportionately large. They fly rapidly, but evidently with much exertion, and with difficulty against the wind, raising the bill above the axis of the body, and propelling themselves at short intervals: are exceedingly destructive to the eggs and young of other birds, which they frequently obtain by dipping their huge bill into the deep pensile nests which abound in their indigenous abode, that organ being remarkably sensitive, which enables them to feel the contents. When roosting at night, they contrive to bury their enormous beak completely between the scapulary and interscapulary feathers; and they employ it with singular dexterity, and are often observed to scratch it gently with the foot, as if that produced an agreeable sensation: many nervous papillæ are distributed over its surface].

THE RESTRICTED TOUCANS—

Have the beak thicker than the head, and are generally black, with vivid colours on the throat, breast, and croup. [Their size is comparatively large, both sexes are alike in plumage, the tail is less cuneated, the clavicle bones are separate, short, and pointed, not joined to constitute a *furcula*. as in Birds in general.]

THE ARICARIS (*Pteroglossus*, Illiger)—

Have the beak not so thick as the head, and enveloped with a less attenuated corneous covering; their

size is inferior, and the ground-tint of their plumage commonly green, with some red or yellow on the throat and breast; [the female is chestnut-brown where the male is black, the tail much graduated, and the furcula (fig. 103) complete.

Among the Aricaris are certain species more vividly green than the rest, the beak of which has a deep, lateral, longitudinal furrow; they are the Groove-bills (*Aulacorynchus*, Gould). The Aricaris generally are more variegated than the true Toucans, to which they bear nearly the same relationship which the Jays and Magpies hold with the Crows. They appear to be less carnivorous].

THE PARROTS (*Psittacus*, Lin.)—

Have a stout, hard, solid beak, rounded on all sides, and enveloped at base by a membrane in which the nostrils are pierced; together with a thick, fleshy, and rounded tongue: two circumstances which impart the greatest facility in imitating the human voice. Their inferior larynx, which is complicated, and furnished on each side with three peculiar muscles, [the bony ring at the divarication of the *bronchi* being besides incomplete, so as to permit of dilatation and contraction,] further contributes to the same object, [if, indeed, it be not entirely produced by the latter means]. Their vigorous jaws are set in motion by a greater number of muscles than are found in other birds, [whence especially results the remarkable mobility of the upper mandible]. They have very long [and remarkably slender] intestines, without cœca; and subsist on fruit of all kinds [together with bulbs and other succulent parts of vegetables in many instances, holding their food up to the mouth with one foot, as with a hand]. Assisted by their hooked bill, they clamber about the branches of trees; nestle in hollow trunks; and have a loud and harsh voice in a state of nature. Nearly all of them are adorned with gorgeous colours, and they are scarcely found out of the torrid zone, [except in the southern hemisphere], but are found in both continents, the species of course differing in each. Every large island even has its own species, the short wings of [many of] these birds incapacitating them from traversing great tracts of sea. The species are therefore extremely numerous, and are subdivided according to the form of the tail and some other characters.

[This extensive group is obviously an ordinal division of the class, and should doubtless rank first in the series of Birds, preceding the Birds of Prey, as among Mammalia the *Quadrumana* do the *Carnivora*. If we except the trivial character of their outer toe being reversed,—and their foot even is in all other respects extremely different, and covered with small tubercle-like scales, instead of plates as in all the *Passerinæ*, and the rest of the yoke-footed genera without exception,—they have absolutely nothing in common with the other *Zygodactyli* that should entitle them to range in the same special division: their whole structure is widely at variance; and if there be one group more than another to which they manifest any particular affinity, it is that of the diurnal, Birds of Prey, which we conceive should range next to them, though still very distantly allied. They certainly accord with the Falcons more than with any other bird in the contour of the beak, and the nostrils are analogously pierced in a membrane termed the *cere:* they have a similar enlargement of the œsophagus, which occurs in no other zygodactyle bird, but which is glandular as in the Pigeons, secreting a lacteal substance with which the young are at first nourished, (the Parrots and Pigeons being almost the only birds which subsist exclusively on vegetable diet at all ages). The stomach is but slightly muscular, and we have found it enormously enlarged in old cage specimens; intestines singularly long and slender, as before stated; and there is no gall-bladder, a particular in which the Parrots accord with the Toucans, the great Cuckoo group, and that of the Pigeons. The sternal apparatus (figs. 104 and 105) differs least from that of the diurnal Birds of Prey, the medial ridge being however rounded anteriorly, and the furcula slight and peculiarly flattened, being least unlike that of the Pigeons, while in one subdivision of Parroquets it is absent altogether. From the rest of the zygodactyle birds, the Parrots differ remarkably in their intelligence and docility, qualities in which some species are unsurpassed by any member of the class; while the other tree birds not framed on the definite type of the *Passerinæ*, are with few exceptions remarkably devoid of intelligence, and incapable of receiving instruction.

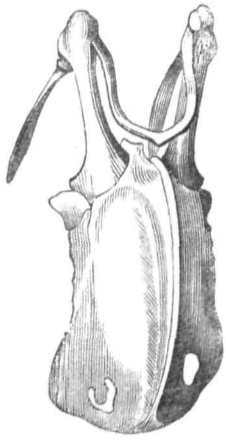

Fig. 104.—Sternum of Parrot.

It may further be noticed, that all the numerous tribe of Parrots conform in every essential detail of their organization, being framed on an especial subtype, which, however it may admit (like every other) of subordinate modifications, exhibits no indication of a passage or transition into any other form: the same remark applies to several of the preceding groups that do not pertain to the *Passerinæ*, but which are lower in the scale than the present one, or, in other words, less distantly removed apart than all are from the latter; that they have not been generally recognized as thus insulated, which all have acknowledged to be the case in the instance of th Parrots, is attributable to their equally constant distinctive characters being less obvious externally.

The Parrots have been arranged under many named subdivisions, the limits of which are mostly arbitrary, though several very natural groups are tolerably distinct.

First, among the species with square tails, we may notice the great Black Cockatoos of Australia (*Calyptorynchus*, Vig.), large crested species, with beak of extraordinary strength, and very deep vertically. Their plumage is black, with some red or yellow on the tail; wings capable of vigorous flight; and food the seeds of the *Eucalypti*, with the juice of which fruit their bills are generally stained. Attempts to maintain them in captivity appear to have always hitherto failed. The subdivision *Corydon*, Wagleri, is barely separable.

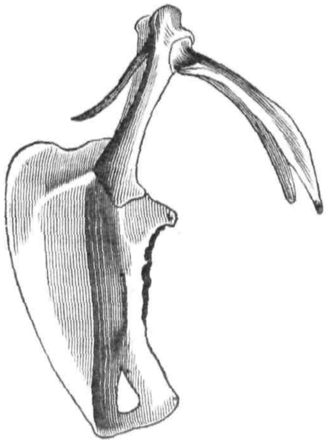

Fig. 105.—Sternum of Parrot.

The White Cockatoos (*Plyctolophus*, Vieillot), the species of which inhabit the Indian Archipelago and Australia, fall into two minor groups according to the form of the crest. Their disposition is singularly gentle and affectionate, and several species are abundantly brought alive to Europe, where they are kept with much facility. Their singular antics and extraordinary grotesque movements are well known to all.

The square-tailed species without crests constitute the restricted Parrots (*Psittacus*) of several authors, and are found in the old and new continents. They are generally esteemed for the facility with which they learn to speak; and the majority are gaily coloured: it is necessary, however, to subdivide them much further. One group, termed *Nestor*, is remarkable for the extraordinary elongation of the upper mandible, which far overhangs the lower: it is believed to be employed in hooking up bulbs: the members of this division are essentially crestless Cockatoos, allied to *Pl. nasicus*, and are also natives of Australia.

The Love-birds (*Psittacula*, Kuhl), compose a beautiful group of species of diminutive size, wherein the tail is slightly graduated; they are found in both continents, and are remarkable for having no furcula.

The Ring Parroquets (*Palæornis*, Vig.), have a very long pointed tail, and collar-like mark round the neck; they inhabit the Asiatic continent and islands, where there are many species.

Australia produces numerous long-tailed Parroquets with more elongated tarsi, adapted for running on the ground; their tail-feathers are not pointed, and their colours are in general gorgeously variegated, and peculiarly mottled on the back. They constitute the *Platycercus*, Vig. and Horsf. *Polyletes*, Wagler, is allied, with pointed tail-feathers; and *Nymphicus* refers to a small species related to the latter, but with the pointed crest of some Cockatoos.

The Maccaws (*Ara*, Kuhl; *Macrocercus*, Vieillot), are long-tailed American species, which exceed all the rest in size, and are superbly coloured. The more characteristic have a large space of naked skin on the cheek, crossed by narrow stripes of short feathers. This bare space is gradually lost as they successively decrease in size, and they finally grade into the American Parroquets (*Conurus*, Kuhl), one species of which (*Ps. carolinensis*, Auct.) is the only member of the Parrot group found northward of the tropic of Cancer.

The Lories (*Lorius*, Vieillot),—are oriental species with square tails, and dense soft plumage, the colours of which are glowing in the utmost degree: beak in general comparatively feeble. Some allied birds are smaller, and have graduated tails, but are particularly distinguished by their extensile tongue having a circle of papillæ at the tip, adapting them to feed on the nectar of flowers: they are termed Lorikeets (*Trichoglossus*, Vigors). *Tanygnathus*, Wagler, includes some Lories with immense bills; and *Coryphilus*, a number of small species, with slender bills, thick skin, and commonly purple colouring. Finally, *Pezoporus*, Illiger, and *Nanodes*, Vig. and Horsf., consist of some beautiful and delicate long-tailed species, which have also feeble bills, and tarsi somewhat elevated; they are known to seek their food chiefly on the ground.*]

Among the Climbers are commonly placed two nearly allied African genera, which appear to me to have also some analogy with the *Gallinaceæ*, and with the Curassows in particular. They have the wings and tail of the latter, [their tail, however, consisting of only ten feathers, instead of fourteen], and like them inhabit trees; their beak is short, and superior mandible bulged, [or compressed and much elevated; the gape remarkably wide]; the feet have a short membrane which connects the external and front toes, though it is true that the outer toe is often directed backward, as observable in the Owls. Their nostrils are simply pierced in the corneous substance of the beak, the cutting edges of the mandibles are dentelated, and the sternum (fig. 106), at least that of the Touraco, has not those two very deep emarginations common to the *Gallinaceæ*.

[Here we have another insulated group, which also comprises the Colies (p. 189), the anatomy of

* We would enumerate some additional subdivisions, but their distinctive characters could not be given with the requisite brevity.

which at once indicates the propriety of arranging it in the present series, among which it is most nearly related to the Toucans. They have but twelve true cervical vertebræ; and the sternum, though singularly small, presents no affinity for that of the Poultry. The stomach is large and but slightly muscular, extending into the abdominal portion of the cavity of the body; and the intestines are short and without cœca. Unlike the Toucans, however, they possess a small gall-bladder; but the tongue, at least in some of them, is similarly barbed towards the tip. The feet have the first and fourth toes directed laterally, for which reason they commonly perch lengthwise on the horizontal branches of trees, which they perambulate longitudinally, clasping the bough with their two laterally disposed toes, while the others are directed forwards. Their movements are light and elegant in the extreme, a particular in which they differ remarkably from the Colies: they pass with an easy sailing flight from tree to tree; live in pairs or families according to the season; subsist almost exclusively upon fruits, and lay four delicate white eggs in the hollows of decayed timber].

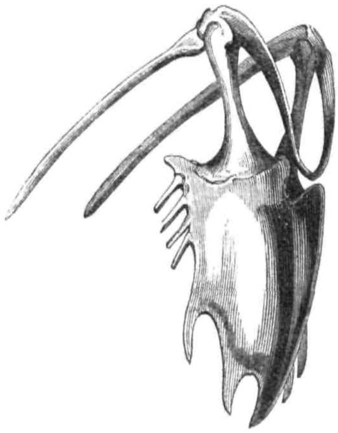

Fig. 106.—Sternum of Touraco.

Such are

THE TOURACOS (*Corythaix*, Illiger),—

The beak of which does not ascend upon the forehead, [and is generally much compressed], and the head is adorned with an erectile crest.

[Seven species are now known, the ground-colour of which is generally vivid-green, with some gorgeous crimson on the open wing. We should observe, that in all this group the feathers are very short upon the rump, being the reverse of what obtains throughout the Poultry. The head, however, is small, as in the latter.]

THE PLANTAIN-EATERS (*Musophaga*, Isert),—

Are so named from the fruit on which they subsist, and are characterized by the base of the bill forming a disk, which covers part of the forehead.

[They grade, however, into the former, the beak becoming more and more inflated, till in one species it forcibly recalls to mind that of a Toucan. Another is of great size, approaching the stature of a Curassow, and has a splendid curled crest, resembling that of several of those birds.

A third genus consists of

THE NAPE-CRESTS (*Chizœris*, Swainson),—

Which have a rounded beak approaching that of some Trogons, and hard and sombre mottled plumage, very unlike that of the others. Their exterior toe is more limited in its range outward by the connecting membrane.

Two species are well known, both from Africa, like all the preceding,—one the *Phasianus Africanus* of Latham.

We here, at length, arrive at a sufficiently marked interruption of the series of the class of Birds, to be enabled to introduce some remarks on the affinities of the preceding orders, which we conceive might be arranged most naturally as follow.

I. SCANSORES, as limited to the Parrots.

II. RAPTORES, or the Birds of Prey; which subdivide into two thoroughly distinct sections.

III. STREPITORES, *Screechers*, consisting of all the remainder that are not organized upon the definite type of the *Passerinæ*. It is necessary to subdivide them first into three series, which might be designated *Syndactyli*, *Zygodactyli*, and *Heterodactyli*; the two first of which names, however, do not rigidly apply in every instance, the groups being founded rather upon the aggregate of the organization, than upon any single character.

1. *Syndactyli*.—These, with the exception of the Motmots, are exclusively animal-feeders, like the *Raptores*, to which they succeed; and even the Motmots subsist more upon animal than upon vegetable diet. They fall under two principal minor groups, which we term *Buceroides* and *Halcyoides*.

The *Buceroides* are distinguished by a very short and heart-shaped tongue, a singly-emarginated sternum, and ten tail-feathers only; intestines short, and we believe always without cœca; plumage never vividly coloured. In order to mark the degree of value of the two very distinct genera included, we conceive it necessary to indicate the Hornbills by the term *Appendirostres,* and the Hoopoes by that of *Arculirostres.* Both are peculiar to the eastern hemisphere.

The *Halcyoides* have a doubly-emarginated sternum, twelve tail-feathers, and, with the sole exception of one group of Kingfishers, splendidly coloured plumage. They fall into three tribes, viz., *Cylindirostres,* comprising the Rollers, Bee-eaters, and Kingfishers, which have tongues similar to the foregoing, membranaceous stomachs, and no cœca; a thick skin, firm plumage (not moulted the first year), and great power of wing; nidificating in holes, and producing numerous shining white eggs, &c.;—*Angulirostres,* composed of the Jacamars and Todies, which have thin, lengthened, lamina-like tongues, muscular gizzards, and great cœca, resembling those of the Owls; thin skin, soft plumage, feeble powers of flight, and which produce coloured or speckled eggs, also in holes;—and *Serratirostres,* or the Motmots, which are intermediate to the *Cylindirostres* and the Toucans, (which commence the next series). The *Angulirostres* and *Serratirostres* are confined in their distribution to America; while the *Cylindirostres,* with the exception of a single subdivision of Kingfishers partly, are found only in the old world.

2. *Zygodactyli.*—The members of this division likewise fall into two principal minor groups, which may be termed *Picoides* and *Cuculoides.* The greater number subsist on mixed diet, and a marked predatory propensity is retained by some.

The *Picoides* have always (at least in every known instance) a doubly-emarginated sternum, comparatively muscular gizzard, and no cœca to the intestine. They all produce white eggs, less spherical than those of the *Syndactyli,* (in which respect the latter approximate the *Raptores,* which precede them); and have an accessory plume to their feathers, more or less developed; their plumage being almost always adorned with vivid colours. It is in this group that the tongue is so variously modified, in the Toucans, Woodpeckers, &c. To bring the species as near as possible together, they may be arranged into two tribes, viz., *Levirostres,* consisting of two very distinct families,—that of the Toucans, and that of the Touracos and Colies; and *Cuneirostres,* comprehending the Woodpecker family (which includes the Honeyguides), and that of the Barbets. The Toucan and Touraco families are respectively peculiar to the old and new worlds, the latter, with the sole exception of two or three Colies, to Africa; the Woodpeckers are generally diffused, excepting in Australia; and members of the Barbet family are found in the warm regions of both hemispheres.

The *Cuculoides* have a comparatively lax stomach, and invariably great cœca, which whenever they occur throughout the *Strepitores* are always of the same proportional dimensions and form as those of the nocturnal Birds of Prey: their colours, excepting in one group of Cuckoos, are never bright; and they have no trace of an accessory plume to the feathers: the greater number lay coloured or speckled eggs, and many construct inartificial nests in bushes, (all the preceding genera, save the Colies only, resorting to holes for that purpose). A great proportion of them have the outer and middle toes more or less directed laterally. They fall under two families only, that of the Courols, Barbacous, and Puff-birds, which have twelve tail-feathers, and that of the Cuckoos, which have only ten or fewer, and which might be again naturally distributed into several supergeneric divisions, or subfamilies. Of these, we can only remark, that that which comprises the parasitic species is peculiar to the old world.

3. *Heterodactyli.*—This group consists of Birds the great majority of which are mainly insectivorous, and take their food on the wing. They are generally endowed, therefore, with considerable power of flight, have a wide gape, and short feet, rarely adapted for progression. The only zygodactyle family of them has the toes differently disposed from those of all other

yoke-footed genera. The species which possess cœca closely accord with the *Cuculoides* in their anatomy, but all of them possess the accessory plume to the clothing feathers, in which they differ from that group. We subdivide them into *Trogonoides* and *Cypseloides*.

The *Trogonoides* consisting of the Trogons only, it will be sufficient to refer to the generic head (p. 216). They have twelve tail-feathers.

The *Cypseloides* have only ten. They divide into two tribes, which may be termed *Parvirostres*, containing the family of Podargues and Moth-hunters, nocturnal species with great cœca, and which lay mottled eggs; and *Tenuirostres*, comprising the two distinct families of the Swifts and Humming-birds, which have no cœca, and lay white eggs, the last-named family differing remarkably from all the preceding *Strepitores* in having a complicated inferior larynx, which character obtains throughout the next order, without a single known exception.

Although the foregoing long series of groups, more or less subordinate, evince a decided mutual affinity and tolerably regular successionship, to those who have practically studied them, we have been unable to detect a single character that will apply to all, and the only one which approximates to being general, consists in the lower larynx being provided with only the sterno-tracheal pair of muscles, save in the single family of the Humming-birds: hence these birds are unable to inflect the voice, and *sing*; and they are generally very inferior in intelligence and docility to the members of either of the three other orders with which we are now engaged; the *Picoides* and Hoopoes constituting the chief exceptions to this generalization. Linnæus obtained a glimpse of their distinctness from the *Passerinæ*, when he instituted his ordinal divisions *Picæ* and *Passeres*; but he fell into error in assigning a position among the former to the Crows, which alone could have induced Cuvier to remark that he could discover no distinctive character to separate the *Picæ* and *Passeres* of his great predecessor.

The series of *Strepitores* can accordingly be defined only by negative characters, derived principally from comparison of them with the *Passerinæ*. Perhaps the most remarkable fact connected with their anatomy, consists in the cœca being invariably either altogether absent, or, if present, developed to a considerable but fixed size, which never varies; this diversity being found to exist in groups that are nearly allied, as in the Swifts and Moth-hunters, the Kingfishers and Todies, &c.

IV. CANTORES, or the restricted *Passerinæ*.—It is impossible for a greater contrast to be afforded than is furnished by this ordinal division and the preceding one. Although comprising many more species and received generic divisions than the three foregoing orders collectively, there is absolutely no essential difference of structure perceptible throughout the whole immense series; the only differences consisting in the degrees of developement of parts common to all: the peculiar type of skeleton, digestive and vocal organs, &c. being invariably one and the same, just as the Humming-bird or Parrot model is analogously varied, in a minor degree. There are no subdivisions equivalent to those which have been indicated as families even of the *Strepitores*, however the beak may vary in magnitude and form; the most dissimilar beaks being often unaccompanied by other marked diversities, so that a dead specimen deprived of its head, although at the first glance it might be referred with certainty to the present order, could only in a few instances be assigned, even on anatomical examination, to any particular group of it, and the plumage and style of colouring would even then afford the surest indication of its affinities, in the great majority of cases. In the *Strepitores*, on the contrary, any one organ, and very commonly a single ordinary clothing feather, would suffice to indicate the very genus from which it had been taken: the varieties in the form of the sternal apparatus may be cited as one illustration of the considerable diversities observable in the whole structure of the *Strepitores*; whereas a single sternal apparatus (fig. 86, p. 178), we have deemed fully adequate to represent the form of this important portion of the skeleton throughout the amazingly extensive series of the present division.* There are, in fact, no

* The sternal apparatus of numerous genera of *Cantores* are beautifully figured in Mr. Yarrell's *History of British Birds*.

characters of dichotomous application, till we descend to minute particulars, such as the seasonal and progressive changes of plumage, the system of coloration, character of the eggs, &c.; and these require to be carefully and extensively studied, in order to extricate the *Cantores* from their present heterogeneous state of artificial arrangement, which, like most other classifications based on the variations of a single organ (the beak), has induced a variety of approximations at variance with natural affinity. To detail our own views on the arrangement of this great order, would require more space than the nature of the present work would allow; it must suffice, therefore, to refer to the few hints which have been given in the details of the various genera.

The four orders here indicated have a vague general character in common, which is not easy to define or even express: it partially consists in the magnitude of the head, as compared with the subsequent divisions generally; and a hind toe being always present, on the same plane with those in front, the great majority of them *perch* and traverse the boughs of trees with comparative facility, while the remainder are too obviously allied to admit of separation].

THE FOURTH ORDER OF BIRDS,—

THE POULTRY, (GALLINÆ, Lin.)—

Are so named from their affinity to the Domestic Cock, in common with which they have generally the upper mandible vaulted, the nostrils pierced in a large membranous space at the base of the beak, and covered by a cartilaginous scale. Their heavy carriage, short wings, and bony sternum (fig. 107), diminished by two emarginations so wide and deep that they occupy nearly its whole lateral portion, its crest being obliquely truncated in front, so that the sharp edge of [an appendage to] the fourchette is only joined to it by ligament, are circumstances which, by greatly impairing the force of the pectoral muscles, render their flight laborious. The tail has generally fourteen, and sometimes eighteen, quill-feathers. Their inferior larynx is very simple, so that none of them can sing. They have an extremely muscular gizzard, and [most generally] a large [globular] crop. If we except the Curassows, they lay and incubate on the ground, on a few carelessly arranged stems of straw or grass. Each male has ordinarily several females, and takes no sort of trouble either with the nest or young ones, which are generally very numerous, and, in most cases, are able to run as soon as they quit the shell.

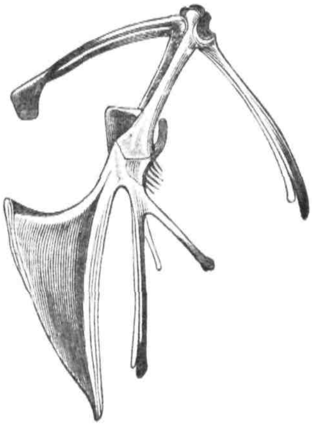

Fig. 107.—Sternum of Red Partridge.

[We should observe, that exceptions occur to almost all these generalizations in the course of the series, which will be pointed out as they arise. In the polygamous species, the male is always larger and more gaily coloured than the female; while in such as are monogamous, (as Ptarmigan and Partridges,) the sexes nearly or quite resemble, both in size and colour. This diversity is apparent in some species that are otherwise closely allied together. The head is very small, as compared with the members of the preceding orders generally; and the number of cervical vertebræ is irregular and always greater.]

The Poultry constitute, for the most part, a very natural family, remarkable for having furnished us with the greater number of our farm-yard fowls, and with much excellent game. Their anterior toes are connected at base by a short membrane, the edges of which are dente-

however, are not prolonged. It also resembles the Peafowl in the brilliancy of the colours of the male: circumference of the eye, and even the cheeks, naked, as in the Pheasants, and the tarsi armed with stout spurs. [The upper mandible very much overhangs the under one, as observable in a less degree in the Pheasants generally, enabling this bird to root up bulbs with facility.]

We know but one species, from the mountains of the north of India, the Resplendent Impeyan (*L. refulgens*, Tem.; *Phasianus Impeyanus*, Lath.). Size of a [small] Turkey, and black; the crest and dorsal plumage of changeable colours, reflecting tints of gold, copper, sapphire and emerald: tail-feathers chestnut-rufous, [and the rump white]. The female and young are brown, dashed with grey and fulvous.

THE TURKEYS (*Meleagris*, Lin.)—

Have the head and upper part of the neck invested with a naked, mammelated skin, an appendage under the throat, and another conical one on the forehead, which becomes inflated and prolonged when the bird is excited by passion, when it hangs over the beak. On the lower part of the neck in front, the adult male has a tuft of very long pendent bristles; the coverts of the tail, shorter and more stiff than in the Peafowl, can be expanded in like manner into a fan. The males have weak spurs, [and are the only American Poultry-birds wherein a trace exists of those appendages].

But one species was known for a long time, the Common Turkey (*M. gallipavo*, Lin.). It was brought from North America during the 16th century, and was soon diffused throughout Europe, where it continues to be reared for the excellency of its flesh, its great size, and the facility with which it is bred. The Wild Turkeys vastly exceed the domestic breed in brilliancy, and are of a greenish-brown, glossed with copper reflections.

A second, however, has been recently described, the Ocellated Turkey (*M. ocellata*, Cuv.), which approximates the Peafowl in the splendour of its colours, and by the disks of sapphirine-blue, inclosed by circles of gold and ruby-red, which adorn the tail-coverts. It was captured in the Bay of Honduras.

[We may here introduce a large Poultry-bird of New Holland,

THE VULTERN (*Alectura*, Gray),—

Which has been strangely arranged by some authors among the Vultures, on account of its bald neck. From the Poultry generally, it is distinguished by the shortness of the downy plumage of the rump, as in the Touracos; its hind-toe is large, and on the same plane with those in front, the same as in the Curassows, like which it is also destitute of spurs; but its tail-feathers are eighteen in number.

One species only is known (*A. Lathami*, Gray), entirely of a dusky colour, the feathers of the under-parts tipped with whitish.]

THE PINTADOS (*Numida*, Lin.),

Or Guinea-fowl, have a naked head, and fleshy wattles below the cheeks, a short tail, and the skull generally surmounted by a callous crest. Their feet are without spurs; the tail short and pendent, so that the long feathers of the croup impart a rounded figure.

The common domestic species (*N. meleagris*, Lin.), originally from Africa [the indigenous habitat of all], has a slate-coloured plumage, everywhere speckled with round white spots [of different sizes]. Its noisy and querulous disposition render it an incommodious species in poultry-yards, although its flesh is excellent. In the wild state, they live in large flocks, and prefer the neighbourhood of marshes.

[Three or four others are known, of which *N. vulturina*, Gould, is the most beautiful, having pointed purple feathers on the lower part of the neck; the body-plumage of all being nearly similar. The Crested Pintado (*N. cristata*, Pallas), is very remarkable for the appendage to the furcula forming a sort of cup, in which the trachea undergoes a convolution. No trace of this structure exists in the common species.]

The great genus of

PHEASANTS (*Phasianus*, Lin.)—

Is characterized by partly naked cheeks, covered with a red skin, and by the tectiform tail, the feathers of which are variously disposed. We first distinguish among them

THE FOWLS (*Gallus*, Cuv.),—

The head of which is surmounted by a vertical fleshy comb, and the inferior mandible furnished on each side with fleshy wattles. Their tail-feathers, fourteen in number, are elevated on two vertical planes, placed back to back; the coverts of that of the male are prolonged to form the arch over the tail proper.

The species so common in our poultry-yards, [absolutely without a special English name] (*Ph. gallus*, Lin.), varies endlessly in colour, and very much in size: there are races wherein the fleshy comb is replaced by a crest of reverted feathers; some in which the tarsi and even the toes are feathered; another in which the crest, wattles, and periosteum of the whole skeleton are black; and some monstrous kinds which have hereditarily five and even six toes to each foot.

Several wild species are also known, as that of Sonnerat (*Gal. Sonneratii*, Tem.), which is very remarkable for the neck feathers of the male, the stems of which widen into three successive disks of a horny nature. The comb of the same sex is dentelated. This species inhabits the Ghauts of Hindostan.

M. Leschenhault has procured two others from Java: one (*G. Bankiva*, Tem.), with a dentelated crest like the preceding; all the feathers of the neck long, pendent, and of the most beautiful golden red: it appears to me to bear the greatest resemblance to our domestic races: the other (*Ph. varius*, Shaw; *G. furcatus*, Tem.), is black, with a copper-green neck, speckled with black, its crest plain, and a kind of small dewlap instead of wattles.

THE PHEASANTS, properly so called (*Phasianus*, Cuv.)—

Have a long graduated tail, each of its quills being inclined on two planes, and covering each other.

The most common of them (*Ph. colchicus*, Lin.), was brought from the banks of the Phasis by the Argonauts, and is now diffused over all temperate Europe, where it requires, however, considerable care. [Another, from China, with a white ring round the neck, and a greener general cast of colour, but otherwise closely allied, has also been turned wild, and produced a prolific race of hybrids with the Common Pheasant, intermediate specimens in every degree being not uncommon. The pure breed of *Ph. colchicus* is distinguished by the total absence of the white ring, and reddish-copper tint of the croup, instead of greenish.

China produces several other species, with most superb plumage, as

The Golden Pheasant (*Ph. pictus*), and Amherst Pheasant (*Ph. Amherstii*), which have both a gorgeous ruff round the neck, and the latter in particular an exceedingly long tail, the feathers widening in the middle.

The Reeves's Pheasant (*Ph. Reevesii*), from the same country, is one of the most magnificent of birds. It is half as large again as the common species, with a tail exceeding six feet in length. *Ph. versicolor*, and *Ph. Soëmeringii*, from Japan, are also truly splendid, and nearly allied to the common one.

Others approximate the Common Fowl in their carriage, as the Silver Pheasant (*Ph. nycthemerus*), from China, and the Lineated (*Ph. lineatus*), from the mountains of Thibet: both these have purple-black under-parts, with the feathers above white and lineated; a pendent crest on the head. *Ph. albocristatus* comes still nearer to the Fowls, retaining the head only of the Pheasant group; and *Ph. pucrasia*, is perhaps the dullest of the whole genus, with a pointed short tail, but is otherwise allied to the ordinary species: the two last are from the Himmalayas]. The females of all are sombre [that of *Ph. Reevesii* the least so, which is beautifully variegated with white upon the neck,] and have shorter tails.

We conceive that the description of the Phœnix, by Pliny, (lib. x. cap. 2), was drawn up from a specimen of the Golden Pheasant.

One of the most singular of all Birds is

The Argus (*Ph. argus*, Lin).—A large Pheasant from the south of Asia, the head and neck of which are almost naked. The tarsi are without spurs; a very long tail in the male; the secondary quills of the wing excessively elongated, widened, and covered throughout their length with ocellated spots, which, when spread out, impart an extraordinary aspect to the bird. It inhabits the mountains of Sumatra and some other countries of the south-east of Asia, and constitutes the genus *Argus* of Temminck.

THE MACARTNEYS (*Euplocomus*, Tem.),—

With the naked cheeks common to this genus, have the vertical tail and arched coverts of the Cocks, together with erectible feathers on the head, which form a crest similar to that of the Peafowl. The projecting lower edge of the naked skin of their cheeks supplies the place of wattles. The tarsi are armed with strong spurs.

We are acquainted with one only, from the Isles of Sunda (*Phasianus ignitus*, Shaw); size of a Cock, and brilliant black, with a golden-red rump, the upper tail-coverts yellowish or whitish, and the flanks spotted with white or fulvous. Female brown, finely streaked with blackish above. and dashed with white beneath; crested like the male. [The *Ph. albocristatus* might be placed with it.]

THE TRAGOPANS (*Tragopan*, Cuv.)—

Are [with the exception of one species] remarkable for the singular adornment of the head, which is almost naked, with a small slender horn [or erectible excrescence] behind each eye, and a wattle susceptible of inflation under the throat. There are short tarsal spurs in both sexes.

[Four species are now known, all beautifully spotted with white, somewhat as in a Pintado, and in three of them upon a gorgeous red ground-colour; the naked parts are also vividly tinted with rich blue and yellow. Females nd young dull brown. They inhabit the Himmalaya range of mountains, and perch like Pheasants].

We should separate from the Pheasant group

THE CRYPTONYX, Tem.,—

Wherein the immediate circumference of the eye alone is naked, the tail is moderate and plain, and the tarsi are without spurs. Their most remarkable character, however consists in the absence of the hind-claw.

In the only well-known species (*Cr. coronatus*, Tem.), the male has a long crest of thinly-barbed rufous feathers, and some long barbless stems over each eyebrow. Plumage bright green and blue. [Another (*Cr. niger*), is wholly black, with the female brown. There are two or three more, all from India and its islands].

THE GROUSE (*Tetrao*, Lin.)—

Form another great genus, characterized by a naked space, generally of a bright red colour, in place of an eye-brow. It is subdivided in the following manner.

THE RESTRICTED GROUSE (*Tetrao*, Latham)—

Have feathered tarsi without spurs. Those to which we more particularly confine the name have a rounded or forked tail, and naked toes. [They are polygamous, and spread the tail and strut in the manner of Turkeys].

The Bearded or Wood Grouse, Capercailzie, or Cock of the Wood (*T. urogallus*, Lin.), is the largest of the true Poultry, surpassing the Turkey in size. Its plumage is slate-coloured, finely rayed with blackish, [the breast shining bottle-green]; female fulvous, barred with brown or blackish. It inhabits the extensive mountain forests of the north of Europe, nestles in the heather or newly-cleared grounds, and subsists on buds and berries, [and particularly pine-shoots]. Its flesh is excellent, and the trachea makes two curves before entering the lungs.

The Black Grouse (*T. tetrix*, Lin).—Black, with some white on the wing-coverts and beneath the tail, the two outermost feathers of which are forked and curled outward. Female fulvous, barbed with whitish and dusky black. Their size that of the Domestic Cock and Hen. Found also in the European mountain forests. [There is a nearly allied species in Siberia].

An intermediate species appears to exist in the north of Europe (*T. intermedius*, Langsdorf). [It is still very doubtful whether this be not a hybrid between the Bearded and Black Grouse.

Several more exist in North America; one (*T. cupido*) is remarkable for a double nuchal crest, and an expansile globular pouch on the sides of the neck, of the colour and size of an orange, which is inflated when the bird is strutting. Others, the *Centrocercus*, Swainson, have sharp-pointed tail-feathers, and shorter wings: they inhabit the open country, and do not perch. Such is *T. urophasianus*, Bonap., the great Cock of the Plains, which is one third smaller than the European Wood Grouse, with some inflatable skin on the sides of the neck.

Others again,

THE BONASIA, Bonap.—

Have a naked strip along the front of the tarsi, and the coronal feathers lengthened; as]

The Hazel Grouse (*T. bonasia*, Lin.).—Scarcely larger than a Partridge, and prettily mottled, grey and rufous. Inhabits temperate Europe. [We have found its crop and stomach filled with birch catkins.] Another (*T. umbellus*, Gmelin), in North America, is about a third larger.

THE PTARMIGAN (*Lagopus*, Cuv.)—

Are species with a round or square tail, the toes of which are feathered like the tarsi. [They are monogamous, and do not strut with expanded tail-feathers]. The more generally diffused species become white in winter.

The Common Ptarmigan (*T. lagopus*, Lin.).—Inhabits our highest mountains, and shelters itself, in winter, in holes which it burrows in the snow [a habit which is also practised by the common Partridge.] The Willow Ptarmigan (*T. saliceti*, Tem.), from the whole north, is larger, with a stouter bill. [Though not found in Britain, like the last, it is the common species of the London markets. Another, still more densely clad (*L. bradydactyla*, Gould), occurs in Russia, and there are additional species in Iceland and in North America].

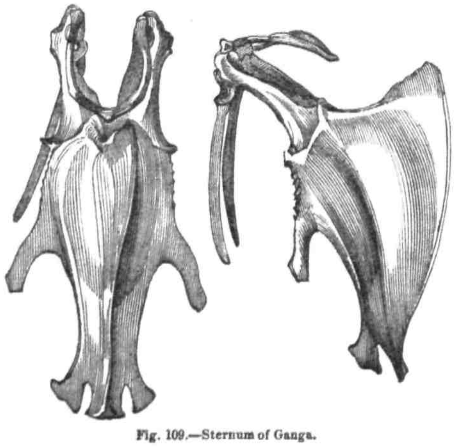

Fig. 109.—Sternum of Ganga.

There is a Ptarmigan in Scotland, however, which does not change colour in winter.

The Heath Ptarmigan (*T. scoticus*, Latham).—[Common *Moor-fowl*, or *Red Grouse* of sportsmen, remarkable for being quite restricted in its distribution to the British islands: it renews its feathers twice a year, however, like the others].

We may here separate by the name of

THE GANGAS (*Pterocles*, Tem.)—

The species with a pointed tail and naked toes. The circumference of the eyes alone is naked, and not of a red colour: their thumb is very small. [The wings are remarkably long and pointed, with the

first quill longest, and flight extraordinarily swift; sternal crest more developed than in any other bird whatever, the inner emargination of the sternum almost obliterated: furcula singularly short and wide, without any appenddage: the alimentary passage resembles that of other Poultry, having cœca as much developed as in a Partridge. The feathers are moulted twice a year, and resemble those of the Bustards, both sexes being alike in winter, and the male acquiring a peculiar garb in summer. They lay few eggs, and the young do not follow their parents for some time, but are fed by them in the nest. They inhabit the arid deserts of Africa and Arabia, and are peculiar to the eastern hemisphere.]

One (*T. alchata*, Lin.), inhabits the south of France and borders of the Mediterranean. [Another (*T. arenarius*, Pallas) occurs in Spain, and a third (*Pt. caspicus*, Menetr.) is found in south-eastern Europe. There are many more.

Closely allied to the Gangas, we deem

THE TETRAOGALLUS, Hardwicke,—

A large species from the mountains of the north of India, with shorter wings and comparatively stout bill. The tarsi are armed with spurs, and the first five quills are nearly equal.

It is the *T. nigelli*, Gray].

THE PARTRIDGES (*Perdix*, Brisson),—

Have the tarsi naked as well as the toes. Among them

THE FRANCOLINS (*Francolinus*, Tem.)—

Are distinguished by their longer and stouter beak, more developed tail, and generally by their stout spurs.

There is one in southern Europe (*T. francolinus*, Lin.), with red feet; the neck and belly of the male black, with round white spots, and a vivid rufous collar.

Some of the foreign species are remarkable either for possessing double spurs, or a naked skin on the throat, or they combine these two characters: others, again, have a particularly large beak, and are without spurs.

THE RESTRICTED PARTRIDGES—

ave the beak not quite so stout: the males have short spurs, or simple tubercles, which are wanting in the females.

Every one is acquainted with

The Grey Partridge (*T. cinereus*, Lin.), that prolific species of game, which lives and propagates in our fields, and is so highly esteemed for the table.

The Red Partridge (*T. rufus*, Lin.) [and five or six others with the same general character of plumage, form a natural group, the first dress of which is analogous to that of the preceding. All are peculiar to the eastern hemisphere.]

THE QUAILS (*Coturnix*, Tem.)—

Are smaller than the Partridges; with a more slender beak and shorter tail: they have neither spurs nor red eyebrow, [and have longer wings. All are peculiar to the eastern hemisphere, where they are generally diffused].

The Common Quail (*T. coturnix*, Lin.), a small European bird, celebrated for its migrations across the Mediterranean. [There are many others.]

THE COLINS (*Ortyx*, Stephens),—

Or Partridges and Quails of America, have a shorter and stouter beak, more convex above: their tail is somewhat larger. They perch on branches, and, when disturbed, even on trees.* Several species migrate like our Quails.

[Some have remarkable recurved topknots, in one of extraordinary length].

We are obliged to separate from the whole genus of Grouse

THE ORTYGANS (*Hemipodius*, Tem.),—

Which have no thumb, and the compressed beak of which forms a slight projection under the lower mandible. They cannot, however, be properly classed until their anatomy is known. The species are polygamous, and inhabit sandy regions.

Some of them,

THE ORTYGANS (*Ortygis*, Illiger),—

Have the general aspect of Quails, with toes separated to their very base, having no small membrane [The chief peculiarity of their anatomy consists in the absence of a craw.]

The natives of Java train one species for fighting (the *H. pugnax*), as Game-Cocks are trained in England.

* The Red Partridges will sometimes do this.—ED.

Others,

THE ATTAGENS (*Syrrhaptes*, Illiger),—

Are so far removed from the general type of the Poultry, that it is even doubtful whether they should range in the present order. [They appear to be nearly related to the Gangas.] Their short tarsi are feathered, as are also the toes, which are short, and joined together for a part of their length; the wings being extremely long and pointed.

But one species is known, from the deserts of central Asia [and very rarely eastern Europe,] (T. paradoxus, Pallas), the *Heteroclyte* of Temminck.

We are equally necessitated to separate from the Grouse

THE TINAMOUS (*Tinamus*, Latham; *Crypturus*, Illiger),—

An American genus, remarkable for a long and slender neck, (although the tarsi are short,) covered with feathers, the tips of the barbs of which are slender and slightly curled, which imparts a peculiar air to that part of their plumage. The beak is long, slender, and blunt at the end; somewhat vaulted, with a small groove at each side: the nostrils are pierced in the middle of each side, and penetrate obliquely backwards. Their wings are short, and they have scarcely any tail. The membrane between the base of their toes is very short. Their thumb, reduced to a spur, cannot touch the ground. They have a small naked space round the eye. These birds either perch on low branches, or conceal themselves in tall grass; they live on fruits and insects, and their flesh is very good. Their size varies from that of a Pheasant down to that of a Quail, or even still smaller. [Eggs of a deep purple colour.]

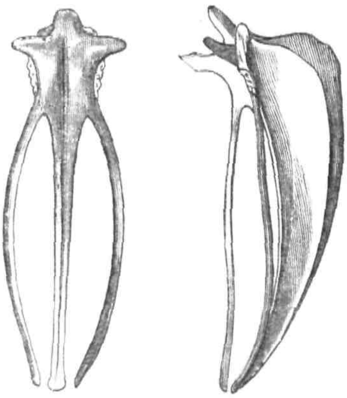

Fig. 110.—Sternum of Tinamou.

Some of them (the *Pezus* of Spix), have a small tail concealed under the feathers of the rump. Others (the *Tinamus* of Spix) have no tail at all, and the nostrils are placed a little further backward.

We should distinguish the *Rhynchotis* of Spix, wherein the beak, which is stronger, has no groove, and is a little arcuated and depressed, with the nostrils pierced towards the base.

THE PIGEONS (*Columba*, Lin.)—

May be considered as forming some passage from the *Gallinæ* to the *Passerinæ*. As in the former, their beak is vaulted, the nostrils are pierced in a large membranous space, and covered with a cartilaginous scale, which even forms a bulge at the base of the beak: the bony sternum (fig. 111) is deeply and doubly emarginated, although somewhat differently [the inner notch being mostly reduced to a foramen; the ridge of the sternum deep, and rounded off anteriorly (much as in the Parrots); and the furcula flat and destitute of any appendage]. The crop (fig. 70, p. 160) is extremely large [and double, or expanding on each side of the œsophagus, in which it differs from that of any other bird; it also secretes a lacteal substance, as in the Parrots, during the period of incubation. The gizzard is powerfully muscular; the intestines very long and slender, with minute cœca; and there is no gall bladder]. The inferior larynx is furnished with but one muscle proper—[we have invariably found two pairs]; but there is no other membrane between the base of the toes than that which results from the continuity of the edges. The tail consists of twelve feathers, and they fly tolerably well. These birds are invariably monogamous, nestle in trees or the holes of rocks, and lay but very few eggs, ordinarily two, though they breed often. Both sexes incubate, and they feed their young by disgorging grain macerated in the crop. They form but one great genus, which naturalists have attempted to divide into three subgenera, from the greater or less strength of the bill, and the proportions of the feet.

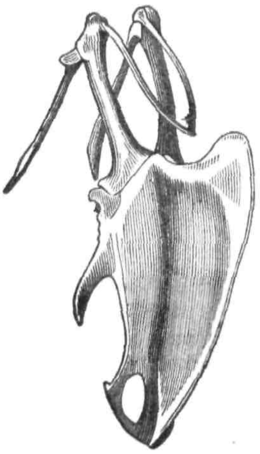

Fig. 111.—Sternum of Pigeon.

THE GOURAS (*Lophyrus*, Vieillot)—

Approximate the ordinary *Gallinaceæ* more than the other subgenera, by their more elevated tarsi and gregarious habits, finding their food more on the ground, and never [not so habitually] perching. Their beak is slender and flexible, [and their anatomy precisely that of the others].

One species is even allied to the *Gallinaceæ* by the caruncles and other naked parts about the head (the *C. carunculata*, Tem.)

Another, at least, approaches them in size, which almost equals that of a Turkey,—the Crowned Pigeon of the Indian Archipelago (*C. coronata*, Gm.).—Entirely of a slaty-blue, with some chestnut and white on the wings; the head adorned with a vertical longitudinal crest of thinly-barbed feathers. It is bred in the poultry-yards of Java, &c., but refuses to propagate in Europe. It is to this species that the names *Goura* and *Lophyrus* especially apply.

A third approximates the Poultry by the long pendent feathers of its neck, somewhat as in the Cock,—the Nicobar Pigeon (*Col. nincobarica*, Lin.), of a brilliant golden-green colour, the tail white. It is found in many parts of the Indian Isles, [and propagates in the same manner as the others, contrary to what has been asserted.

Other small species compose the *Chæmepelia*, Swainson, as the Ground Dove of Wilson's American Ornithology, *C. passerina*, Lin.]

THE RESTRICTED PIGEONS (*Columba*, as limited)—

Have shorter legs than the preceding, but the same flexible and slender bill.

There are four wild species in Europe.

The Cushat, or Ring Dove (*Col. palumbus*, Lin.), is the largest of them. It inhabits forests, and more particularly those of evergreens, and is of a bluish ash-colour, rufous beneath, and distinguished by a spot of white on each side of the neck. [It nestles on the branches of trees.]

The Stock Pigeon (*C. œnas*, Lin.).—Of a slaty-grey colour, vinous beneath, with some changeable green upon the neck. Rather smaller than the last, and similar in its general habits. [It breeds, however, either in convenient holes of trees, or in leafy pollards termed *stocks*, and not unfrequently in rabbit-burrows; makes no flapping sound with the wings in flying, like the next species].

The Rock Pigeon (*C. livia*, Brisson).—Slaty-grey, some iridescent green on the neck, two black bars on each wing, and a white rump. The Dovecot Pigeon is derived from this species, and, it would appear, the greater number of the innumerable domestic breeds, in the production of which, however, the admixture of some proximate species may likewise have an influence. [The wild Rock Pigeon breeds principally in sea-cliffs, and but sparingly inland. There is a race, which we suspect to be a distinct species, closely allied, the wings of which are spotted, somewhat as in the Stock Pigeon, but more extensively, in place of the black bars. Numbers of them, all shot, are sold in the London markets. We will term it *C. macularia*].

The Turtle Dove (*Col. turtur*, Lin.).—A fulvous-brown mantle, spotted with brown, the neck bluish, with a spot on each side, variegated black and white. It is the smallest of the European wild Pigeons, and resembles the Cushat in its habits, [excepting in being migratory].

The Collared Dove (*Col. risoria*, Lin.), appears to have been originally from Africa. It is of a reddish-white colour, pale below, with a black collar on the neck.

The species of this division are extremely numerous, and might be further subdivided according as the tarsi are naked or feathered, and upon the naked space surrounding the eyes of some of them. Those with feathered tarsi constitute the *Ptilinopus*, Swainson.

Some have even caruncles and other naked parts on the head: and there are others [the *Ectopistes*, Swainson], which might be separated on account of their pointed tail.

But the best of all the divisions that have been instituted among the Pigeons is that of

THE VINAGOS (*Vinago*, Cuv.),—

Which are recognized by having a stouter bill, of solid substance, and compressed laterally: their tarsi are short, and their feet large and well bordered. They inhabit extensive woods, and subsist on fruit. But few species are known, all from the torrid zone of the eastern continent.

[They have generally vivid-green plumage, variegated with bright yellow]. One has a pointed tail.

THE FIFTH ORDER OF BIRDS,—

THE STILT-BIRDS (GRALLÆ, Lin.),—

Also termed *Shore-birds* and *Waders*, names which are derived from their habits and conformation. The members of this division are recognized by the nudity of part of the tibia, and most commonly by the elongation of the tarsi; conditions which permit them to enter

in New Zealand, where some bones of it have been found, and a tradition of its destruction is preserved by the inhabitants.]

N. B.—We cannot with propriety admit into this series, species so little known, or so ill-authenticated, as those which compose the genus of

DODOS (*Didus*, Lin.),—

The first species of which (*D. ineptus*) is only known from the description of it by the early Dutch navigators, preserved in Clusius (*Exot.* p. 99), and by an oil-painting, of the same epoch, copied by Edwards, pl. 294; for the description by Herbert is puerile, and all the rest are copied from Clusius and Edwards. It seems that the species has entirely disappeared, for at the present time there is only a foot of it extant in the British Museum, and an ill-preserved head in the Ashmolean Museum at Oxford. The beak appears to be not without some resemblance to that of the Awks, and the foot would resemble that of the Penguins, had it been palmated. [Since this was written, the author personally examined these last precious remains of the now extinct Dodo, and was not merely satisfied of their validity and total generic distinctness, but expressed an opinion that the foot also preserved at Oxford was specifically different from that in the British Museum.]

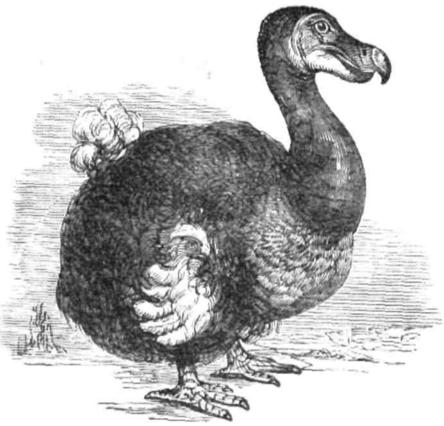

Fig. 115.—The Dodo.

The second species (*D. solitarius*) rests on the sole testimony of Leguat (*Voy.* i. p. 98), a man who has misrepresented well-known species of animals, as the Hippopotamus and Manati.

The third, or Bird of Nazareth (*D. nazarenus*), is only known from the account of François Carechi, who considers it the same as the first species, giving it however but three toes, while all the others allow that bird to have four. No one has been able to inspect any of these birds since the time of those voyagers.

THE APTERYX, Shaw,—

Appears, of all Birds, to have the wings most completely reduced to simple rudiments. Its general form is that of a Penguin, and size that of a Goose. The feet also bear some resemblance to those of the Penguins, but are not described to be palmated. The beak is very long, slender, marked on each side with a longitudinal groove, and furnished with a membrane at its base: [the nostrils are placed at the top of the upper mandible beneath, which passes beyond the under one]. Wing reduced to a little stump, terminated by a hook.

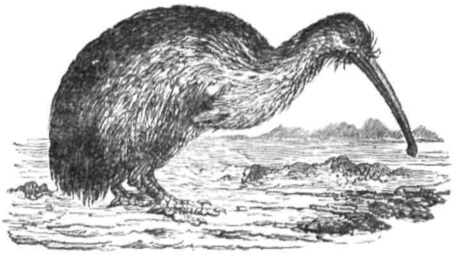

Fig. 116.—The Apteryx.

[Several specimens of this singular bird have recently been received, more particularly in England, and its characters are now tolerably determined. It has no relationship whatever with the Penguin group, but there is every reason to place it in the present family. From all other birds, it differs in the completeness of its diaphragm, and in the absence of abdominal air cells; none of its bones are hollow. The sternum is exceedingly reduced, with one deep posterior emargination on each side, and also a pair of anomalous perforations or foramina towards the middle: the ribs are extraordinarily broad, and a single pair of vocal muscles are attached to the coracoids: stomach but slightly muscular, and intestines of mean length, with moderate-sized cœca. The feathers have no accessory plume, and their shafts are prolonged considerably beyond the barb; there are many long vibrissæ about the base of the bill, which is invested with a ceral membrane. The feet have a short and elevated hind-toe, the claw of which is alone externally visible. The dimensions of the female appear to exceed those of the male, and her bill is longer. Size that of a domestic fowl, and colour deep brown.

This very interesting bird is nocturnal in its time of action, and subsists on insects. It runs with rapidity, and defends itself vigorously with its feet. Its native name is *Kivi-kivi*, derived from its cry.]

The family of

PRESSIROSTRES—

Comprehends a number of genera with elongated tarsi, in which the back-toe is either qu[ite] absent, or so short as not to reach the ground. Bill moderate, but strong enough to penet[rate]

the ground in search of worms, [to obtain which they have the habit of patting with the feet, which causes the worms to rise] : those species in which it is more feeble frequent meadows and newly-ploughed land, where this food can be procured with greater ease : those which have stronger bills, subsist additionally on grain, herbage, &c.

THE BUSTARDS (*Otis*, Lin.)—

With the heavy port of the Poultry, combine rather a long neck and legs, together with a moderately stout bill, the superior mandible of which is slightly arcuated and vaulted; and they also further approximate the *Gallinaceæ* by the very small membrane at the base of their toes: but the nudity of the lower portion of the tibia, their whole anatomy, and even the flavour of their flesh, concur to place them in the present order, in common with various members of which they also want the back-toe, and the smaller species are nearly allied to the Plovers. They have reticulated tarsi, and short wings; fly little, hardly ever using their wings, except to assist them in running, the same as the Ostriches; and feed equally on grain, herbage, and worms and insects. [The stomach is very capacious, and extremely attenuated, contrasting remarkably with the muscular gizzard of the true Plovers; their plumage is moulted twice in the year, the males of most of them developing accessory ornamental feathers, or black under-parts, in the spring; and their flight, when they do fairly rise, is easy and winnowing, and capable of considerable protraction. The species are numerous, and confined to the Eastern Continent.

The two first, one indigenous, the other an occasional visitant, in the British Isles, possess a comparatively stout beak, which is compressed laterally.]

The Great Bustard (*O. tarda*, Lin.).—Bright buff-coloured plumage on the upper-parts, crossed with numerous black lines; elsewhere greyish-white. The male, which is the largest of European birds, has [in its summer dress] lengthened ear-coverts, which form a sort of large moustache on each side. This species, which is one of the finest kinds of game, frequents extensive plains, and nestles on the ground amongst the corn. [It is polygamous, and the female is much smaller than the male; the latter being further distinguished by a very capacious membranous sac beneath the tongue. The voice of the male is a remarkable explosive sound. This bird lays only two eggs, of a dark greenish colour, with some black patches: the young, when first hatched, are very like young Plovers. It has been nearly extirpated in Great Britain.]

The Little Bustard (*O. tetrax*, Lin.).—Less than half the size of the last species, and much less widely diffused; of a brown colour, speckled with black above, whitish underneath. The male with a black neck, [in summer plumage only,] and two white collars. [In this species, the sexes scarcely differ in size, from which we should infer that it is monogamous. It lays four or five spotless green eggs in corn-fields, and is also highly esteemed for the table.]

The greater number of exotic species have the bill more slender, [and depressed instead of compressed]. Among them we may remark

The Ruffed Bustard (*O. houbara*, Desm.), of Africa and Arabia, [and rarely Spain, the male of] which is adorned with lengthened feathers on the sides of the neck. [Another species with this character exists in central Asia.]

THE PLOVERS (*Charadrius*, Lin.)—

Likewise want the hind-toe, and have a middle-sized bill, compressed, but swoln towards the tip. They may be divided into two subgenera.

THE THICK-KNEES (*Œdicnemus*, Tem.),—

Wherein the tip of the bill is inflated above as well as beneath, and the groove of the nostrils extends only half the length of the beak. They are the largest of the Plover group, and live by preference upon arid and stony districts, feeding on slugs, insects, &c. They are allied to the smaller species of Bustards [in their exterior conformation, but not in the structure of the stomach, which is a muscular gizzard: their plumage also is moulted once only in the year, and they undergo no seasonal change of colour]. Their legs are reticulated, and they have a short membrane at the base of their three toes.

The European Thick-knee (*Ch. œdicnemus*, Lin.; *Œd. crepitans*, Tem.).—Size of [larger than] a Woodcock, and fulvous-grey, with a brown streak along the middle of each feather; the belly white, and a brown space under the eye. [This is the *Stone Curlew*, *Whistling* or *Norfolk Plover*, as it is variously designated, which is common in several districts of South Britain, and well known wherever it occurs from its sonorous whistling. It lays but two eggs, which however do not resemble those of the Bustards, and taper at one end; the smaller Bustards (as we have seen) produce a greater number. The Thick-knees are for the most part migratory, but some regularly stay the winter. We have reason to believe that it rears more than one brood in a season. There are several exotic species, some considerably larger and much stouter].

THE RESTRICTED PLOVERS (*Charadrius*,)—

Have the beak swoln only above, and two-thirds of its length occupied by the nasal groove on each side, which renders it weaker. They live in numerous flocks. frequent low and humid places, and stamp the ground to cause the worms on which they feed to rise.

Those of France are merely birds of passage, which are met with in autumn and spring; near the sea-coast some of them remain till the beginning of winter. [They all breed, however, within the British isles, and at least some of them in France also.] Their flesh is excellent. They form, with numerous exotic species, a tribe with reticulated tarsi, of which the most remarkable are

The Golden Plover (*Ch. pluvialis*, Lin.).—Blackish, speckled with yellow at the tips of the feathers; the belly black [in summer, in winter white. It breeds on upland moors. There are others very closely allied, but smaller, in India, Australia, and North America].

The Dottrel Plover (*Ch. morinellus*, Lin.).—Grey or blackish, the feathers edged with whitish fulvous; a white streak over the eye, the breast and upper part of the belly bright rufous, and the lower part of the belly white. [It breeds on the very summits of mountains uncovered by snow; flies in large scattered flocks, which are not shy; and is partial to chalky districts: its feathers are much esteemed by anglers.]

The Ring Plover (*Ch. hiaticula*, Lin.).– Greyish brown above, white beneath, with a black [or in winter a brown] collar on the lower part of the neck, very broad anteriorly; the head marked with black and white, and the beak yellow tipped with black. Two or three races or different species inhabit these parts, varying in size and the distribution of the colours of the head. [Those of Britain are, first, the common Ring Plover, with plumage as above described, and orange-coloured legs, which is everywhere very abundant on the sea-coast, breeding both there and on heaths a little inland; the Kentish Plover (*Ch. cantianus*), with longer and black legs, and a rufous occiput, an inhabitant of shingle-beaches, and less deeply coloured; and the Little Plover (*C. minor*), which is a diminutive of the first, and of excessively rare occurrence so far north.] There are numerous other foreign species, with similar general distribution of colours.

Various exotic Plovers have scutellated tarsi, and form a small division (the *Pluvianus*, Vieillot), of which the greater number of species possess spurs to the wings, and fleshy wattles to the head; some of them have both these characters.

THE LAPWINGS (*Vanellus*, Bechst.; *Tringa*, Lin.)—

Have the same beak as the Plovers, and are only distinguished by the presence of a back-toe, which however is so small that it does not reach the ground.

In the first tribe of them (the *Squatarola*, Cuv.), this back-toe is scarcely perceptible. The bill is swoln underneath, and the nasal groove as short as in the Thick-knee. The feet are reticulated, and the tail of the European species is rayed black and white. It associates with the Plovers.

The Grey Lapwing, or Stone Plover (*Tringa squatarola*, Auct.)—[This bird differs only from the Golden Plover in the stoutness of its bill, and in possessing the small back toe. Its seasonal changes are the same, having the under-parts black in summer and white in winter; the feathers above are similarly mottled, only with whitish instead of yellow, except in the young, which is even speckled with yellow. From the true Lapwings and the *Pluviani*, this bird and the restricted Plovers differ in their pointed wings and reticulated tarsi; the latter having scutellated tarsi, broad and rounded wings, and a different system of coloration. Its habits are precisely those of the Golden Plover, and it breeds on some of the northern British moors.]

THE RESTRICTED LAPWINGS (*Vanellus*, Cuv.)—

Have the hind-toe rather more developed, the tarsi scutellated, at least in part, and the nasal fossa prolonged over two-thirds of the beak. They procure worms in the same manner as the Plovers, [and are peculiar to the eastern hemisphere].

That common in Europe, the Crested Lapwing (*T. vanellus*, Lin.), is a handsome species the size of a Pigeon, of a richly bronzed black above, with a long and slender occipital crest. [Throat black in summer and white in winter, at which latter season the colours are comparatively dull.] It arrives in spring, lives and propagates in the meadows, and departs in autumn. The eggs are considered a great delicacy.

There are some species of this genus in hot climates, the wings of which are armed with one or two spurs, and others which have fleshy wattles at the base of the beak. They are very noisy birds, screaming at every sound they hear, and defend themselves with courage against birds of prey. Live also in the meadows. [A second European species of Lapwing, from the south-eastern countries, is the *V. gregarius*, Pallas, or *V. keptuscka*, Tem.]

THE OYSTER-CATCHERS (*Hæmatopus*, Lin.)—

Have the beak rather longer than in the Plovers and Lapwings, straight, pointed, and compressed into a wedge; strong enough to enable them to force open the bivalve shells of the mollusks on which they feed. They also seek for worms upon the ground. The nasal groove, which is very deep, occupies half the length of the bill, and the nostrils are pierced in the middle like a small fissure. Their legs are of mean length, the tarsi reticulated, and the feet divided only into three toes.

That of Europe (*H. ostralegus*, Lin.) is commonly termed *Sea-pie*, from its black and white plumage; the belly, throat, and base of the wings and tail, being of the latter colour; beak and feet bright orange-red. [There are several more.]

We shall place near the Plovers and Oyster-catchers

THE COURSERS (*Cursorius*, Lacepede; *Tachydromus*, Illiger),—

The beak of which, more slender, but equally conical, is arcuated, without any groove, and moderately cleft; the wings are shorter, and the legs more elevated, and terminated by three toes, without any thumb or palmature. [They approximate the Bustards in appearance and habits, and have a similar large membranous stomach; but do not change colour with the seasons, and are very much smaller: are peculiar also to the eastern hemisphere].

One has been met with, but very rarely, in France and England, which is indigenous to the north of Africa, the Cream-coloured Courser (*C. isabellinus*, Meyer), of a pale fulvous colour above, white beneath, [the young transversely rayed above with narrow dusky lines. There are several others.]

As far as can be judged from the exterior, it is here that we should also place

THE CARIAMA (*Microdactylus*, Geoff.; *Dicholophus*, Illiger)—

Which has a longer beak, more curved, and cleft as far as the eye, which imparts somewhat of the physiognomy and disposition of the Birds of Prey, approaching also a little to the Herons. The legs, scutellated and very long, terminate in three short toes, a little palmated at the base, together with a thumb that does not reach the ground.

[This curious bird is most nearly related to the Guans, and should rank in the Poultry order: the affinity is particularly apparent when it is seen alive. In its anatomy, it chiefly differs from the Gallinaceous type in wanting the appendage to the furcula, which latter is otherwise similar to that of a Fowl, and in having the sternal emarginations much less deep. It is essentially a Poultry bird with the long legs of a Crane; but differs in its short and elevated hind-toe from the Carassows and Guans].

We are acquainted with one species only, from South America, (*M. cristatus*, Geoff.; *Palamedea cristata*, Gm.; *Saria*, d'Az.), which surpasses the Heron in size, and subsists on Lizards and insects, which it hunts for on high grounds and along the borders of forests. Plumage yellowish-grey, waved with brown; some thinly-barbed feathers at the base of the beak, forming a slight crest, which is thrown backward. It flies but seldom, and then badly; and its loud voice resembles that of a young Turkey. As its flesh is esteemed, it has been domesticated in several places.

The family of

CULTRIROSTRES

Is known by a long, thick, and stout beak, which is most generally trenchant and pointed, and is almost entirely composed of the birds comprehended in the genus *Ardea* of Linnæus. In a great number of species, the trachea of the male [and of the female also] forms various curves: their cœca are short [or moderate], and the true Herons have even only one.

We subdivide it into three tribes, the Cranes, the Herons properly so designated, and the Storks.

The first tribe forms but one great genus, that of

THE CRANES (*Grus*, Cuv.),—

Which have a straight beak, but slightly cleft; the membranous groove of the nostrils, which is large and concave, occupying nearly half its length. Their legs are scutellated, with toes of moderate length; the external but slightly palmated, and the thumb barely reaching to the ground. A more or less considerable portion of the head and neck is bare of feathers in nearly all of them. Their habits are more terrene, and their nourishment is derived more from vegetables, than in the following genera: they have accordingly a muscular gizzard, and tolerably long cœca. The inferior larynx is provided with only one muscle at each side.

At the head of the genus we place, as Pallas has already done,

THE AGAMI (*Psophia*, Lin.),—

Which has a shorter beak than the others, the head and neck invested merely with down, and the circumference of the eyes naked. They live in the woods, and subsist on grain and fruits.

The best known species (*Ps. crepitans*, Lin.), inhabits South America, and is called the *Trumpeter*, from its faculty of producing a low, deep sound, which at first seems to proceed from the anus. It is the size of a large Capon; plumage black, with reflections of brilliant violet on the breast; and an ashy mantle tinged with fulvous above. This bird soon recognizes persons, becomes attached to them like a Dog, and when domesticated, it is said, may be left to take charge of other poultry. It flies badly, but runs with great swiftness, and nestles on the ground at the foot of a tree. Its flesh is considered good eating.

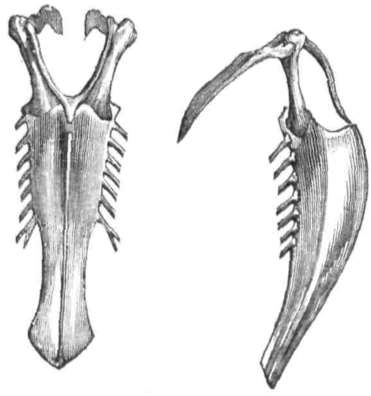

Fig. 117.—Sternum of the Agami.

[The location of this very singular species among the Cranes, is by no means satisfactory; but we do not know that it can be placed to greater advantage elsewhere. Its port resembles that of the Struthious birds (or *Brevipennes*); and the configuration of the sternum (fig. 117) is unique, not even approaching that of any other group. The trachea is much elongated, and continued under the skin of the abdomen, which occasions the sound of its voice to appear to come from that part. Upon the whole, we conceive that it is as nearly allied to the Tinamous, which inhabit the same region, as to any other known genus, and would prefer to detach it in a more marked manner from that of the Cranes. It has also some remote affinity with *Palamedea*.

THE RESTRICTED CRANES (*Grus*, Bechstein)—

Have ample wings, and considerably longer neck and legs. Their figure is much more elegant and graceful; and they feed on corn, and upon reptiles; chiefly frequenting humid districts in flocks that are often numerous. They do not run with speed; but have singular habits of attitudinizing, with expanded wings, and circling around each other with a light and tripping step. Their voice is very loud and harsh. Naturalists have further subdivided them, first into

THE BALEARICANS (*Balearica*, Vigors),—

The occiput of which is adorned with a peculiar bushy crest, composed of erect and crimpled barbless stems of equal length; the forehead is clad with short and close feathers, of velvety appearance; and the throat is furnished with fleshy wattles. The sternum resembles that of a Heron; but the furcula is not anchylosed to its ridge, as in the others, nor does the trachea undergo any convolution; the laryngeal muscles are attached to the first true ribs. These birds perch with facility, and are very readily domesticated.

Two species are known, from eastern and western Africa respectively; the first with a pale grey neck, and much larger fleshy wattles, (*B. regulorum*); the other, which is more commonly brought alive to Europe, having a blackish neck and small wattles (*B. pavonia*). Both have also naked cheeks.

The rest have lengthened tertials, and no crest: the furcula is soldered to the sternal keel, and the latter is hollow and inflated to receive the trachea, which undergoes a convolution within it, as in several Swans. Such are

THE DEMOISELLES (*Anthropoides*, Vigors),—

Which have the head and neck quite feathered, and the tertials hanging over the tail to reach the ground. They are confined to Africa, like the last.

The Paradise Demoiselle (*G. paradisæus*, Vieillot; *Anth. Stanleyanus*, Bennett).—A large species, entirely of a delicate ashy-grey colour; the plumage of the head short and erectile, having very much the appearance of inflatable skin. The Numidian Demoiselle (*Ardea virgo*, Lin.) is much smaller, and characterized by a black neck, with two elegant whitish tufts on the sides of the head, formed by the prolongation of the ear-coverts.

Finally,

THE TRUE CRANES (*Grus*, Vigors)—

Have the beak as long as the head, or longer; the head and part of the neck generally naked; and the tertials commonly recurved. The species are comparatively numerous, and much more widely distributed. Habits migratory.

One is common in Europe, and sometimes occurs, but as an exceedingly rare straggler, in the British Isles, the European Crane (*Ardea grus*, Lin.; *Grus cinerea*, Bechst.)]—Four feet and upwards in height, of an ash-colour, with a black throat; the summit of the head red and naked. This bird has been celebrated from the earliest ages, on account of its regular migrations, from north to south in the autumn, and back in the spring, which it effects in numerous and well-ordered flocks. It feeds on grain, but prefers the worms and insects of marshy

grounds. The ancients frequently speak of it, because the principal course of its migrations appears to be through Greece and Asia Minor.

Between the Cranes and Herons may be placed

THE COURLAN [(*Aramus*, Vieillot),]

The beak of which, more slender and rather more deeply cleft than that of the Cranes, is swoln near the terminal third of its length; and the toes are comparatively long, without any basal membrane. [Its anatomy approaches that of the Rails].

The species (*Ard. scolopacea*, Gm.), resembles the Herons in size as well as manners, and has brown plumage, with some white pencils on the neck.

Also

THE CARLE (*Europyga*, Illig.),—

With a beak more slender than that of the Cranes, but marked with a similar nasal groove, and split nearly to the eyes, as in the Herons, but having no naked skin at its base.

It is a bird the size of a Partridge, with a long and slender neck, broad open tail, and rather short legs, which altogether impart a very different aspect from that of the wading birds in general. Its plumage, shaded with bands and lines of brown, fulvous, russet, grey and black, recalls to mind the colouring of some of the most beautiful Moths. It is found along the rivers of Guiana; [and we suspect is closely allied to the African genus *Rhynchæa*].

The second tribe is more carnivorous, and is characterized by its stronger beak, and longer toes: [they mostly nestle upon trees in large societies, and the young are at first helpless and naked]. At its head may be placed

THE BOATBILLS (*Cancroma*, Lin),—

Which would completely resemble the Herons in the strength of their bill, and the kind of nourishment resulting therefrom, were it not for the extraordinary form of that organ; as, upon close examination, we find that it is merely the beak of a Heron or Bittern, very much inflated: in point of fact, the mandibles are singularly wide from right to left, and formed like the bowls of two spoons, the concave sides of which are placed in contact. These mandibles are very stout and sharp-edged, and the upper one has a pointed tooth on each side of its tip; the nostrils, pierced towards the base, are prolonged into two parallel grooves to near the end. The feet have four toes, all of them long, and nearly without connecting membrane; for which reason these birds perch on the branches of trees by the sides of rivers, from which they precipitate themselves on the fish, which constitute their ordinary food. Their gait is slow, and their attitudes constrained like those of the Herons. [The Boatbills are, in brief, simply modified Herons, from which they differ only in their inflated beak, conforming in their whole anatomy.]

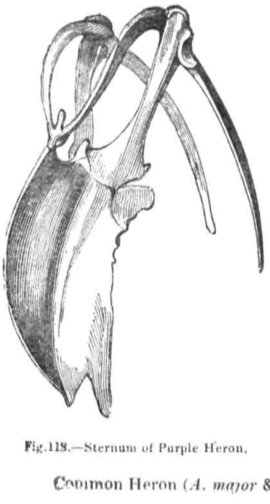

Fig. 118.—Sternum of Purple Heron.

The known species (*C. cochlearea*, Lin.), is the size of a common Fowl, and whitish, with a grey or brown back, the belly rufous, and forehead white; head adorned with a black calotte, which, in the adult male, becomes a lengthened crest: it inhabits the hot and humid regions of South America.

THE HERONS (*Ardea*, Lin.),—

Have the beak cleft as far as the eyes, with a small nasal fossa prolonged into a groove nearly to the point: they are also distinguished by the pectinated inner edge of the claw of their middle toe. Their legs are scutellated, with the toes (including the hind one) rather long [and articulated on the same plane]: the palmature of the outer ones is considerable, and their eyes are placed in a naked skin, which extends to the beak. Their stomach is a very large sac, but slightly muscular, [the intestines extremely long and slender,] and they have only one minute cœcum. They are unlively birds, which nestle and perch by the sides of rivers, and consume a vast quantity of fish. The species are very numerous in both continents, and can scarcely be distinguished except by differences of plumage.

The True Herons have a very slender neck, with long and pendent feathers towards its base. As

Common Heron (*A. major* & *A. cinerea*, Lin.).—Bluish ash-coloured, with a black occipital crest; the neck

That of Ceylon (*T. leucocephalus*) is the largest of all, and has also the thickest bill. Its beak, and the naked skin of the face, are yellow, the plumage white, with black quills and cincture round the breast, and long roseate plumes on the croup, which are shed during the rainy season. A fourth may be added, the *T. lacteus* of Temminck.

THE SPOONBILLS (*Platalea*, Lin.)—

Approximate the Storks in their whole structure, but their beak, from which their name is derived, is long, flat, and broad throughout its length, widening and flattening more particularly at the end, so as to form a round spatula-like disk; with two shallow grooves extending its entire length, without being exactly parallel to its edges. The nostrils are oval, and pierced at a small distance from the origin of each groove. Their minute tongue, reticulated tarsi, the somewhat considerable palmature of their toes, their two very small cœca, but slightly muscular gizzard, and inferior larynx without any peculiar muscles, are the same as in the Storks; but the expansion of their bill deprives it of all its strength, and unfits it for any thing but turning up sand, or picking up small fish and aquatic insects.

The White Spoonbill (*Pl. leucorodia*, Gm.).—Entirely white, with an occipital crest. It is common throughout the ancient continent, and nestles in high trees. [The trachea normally undergoes in both sexes a small convolution resembling the figure 8, but we have dissected one female wherein it proceeded straight to the divarication of the bronchi, and was furnished with a small pair of muscles].

The Roseate Spoonbill (*Pl. ajaja*).—A naked visage, and vivid roseate tints of different shades upon the plumage, which deepen with age. It is properly an inhabitant of South America.

The family of

LONGIROSTRES

Consists of a multitude of Shore-birds, the greater number of which were comprehended by Linnæus in his genus *Scolopax*, and the rest confounded by him in that of *Tringa*, though partly in opposition to the character assigned to the latter, of having the back-toe too short to reach the ground. Lastly, it contains a few that have been placed with the Plovers, on account of the total absence of the hind toe. The whole of these birds have nearly the same conformation, the same habits, and most frequently the same distribution of colours, which render it difficult to distinguish between them. They are generally characterized by a long, slender, and feeble bill, which only permits them to bore in the mud in search of worms and small insects; and the various slight modifications in the form of this beak enable us to arrange them into genera and subgenera.

[We should observe that the distinction between this group and the *Pressirostres* is extremely vague, or rather, with certain reservations, that they compose but one series, plainly characterized by their anatomy. The sternal apparatus of the Knot Sandpiper (fig. 119.) may serve as a specimen of this portion of the skeleton throughout the whole, the few modifications which occur of it being inconsiderable. The stomach (save in the Bustards and Coursers, which in other respects are the least conformable among them), is always a muscular gizzard, and the intestines long, with small or moderate cœca, and invariably a distinct cœcal remnant of the umbilical vessel. The females (except in the very few species of polygamous habit), are larger than the males, and they almost invariably lay four eggs on the ground, upon little or no nest, and dispose them with the small ends inwards; the young following their parents as soon as they burst the shell].

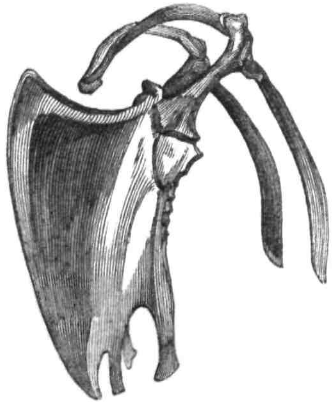

Fig. 119.—Sternum of the Knot Sandpiper.

According to his own principles, Linnæus should have classed most of these birds in his great genus of

THE SNIPES (*Scolopax*),—

Which we divide as follows, from trivial variations of the form of the bill.

THE IBISES (*Ibis*, Cuv.).

We separate these from the *Tantali* of Gmelin, on account of their beak, which, though arcuated as in

the latter, is much more feeble, and devoid of emargination at the tip; besides which the nostrils, pierced towards the back and base, are prolonged in a groove which reaches to the end. This beak is also tolerably thick, and nearly square at the base, and some parts of the head or even of the neck are always bare of feathers. The external toes are considerably palmated at base, and the thumb sufficiently long to bear upon the ground. [The gradation is, in fact, quite imperceptible from these to the Tantals, and the anatomy and character of the plumage concur to show that both naturally pertain to the preceding division of *Cultrirostres*: we believe the Ibises also build in society upon trees; and there is certainly no trace of a passage from them into the Scolopaceous birds.] Some of them have short and reticulated legs; and these are also more robust, and have a thicker bill.

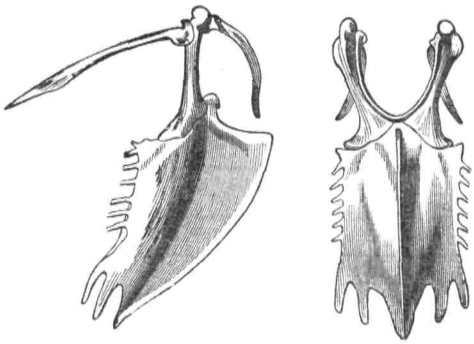

Fig. 120.—Sternum of Glossy Ibis.

The Sacred Ibis (*I. religiosa*, Nobis; *Abou Hannès*, Bruce; *Tantalus Æthiopicus*, Latham), is the most celebrated species. It was reared in the temples of ancient Egypt, with a degree of respect bordering on adoration; and was embalmed after its death. This arose, according to some, from its devouring serpents, which would otherwise have multiplied to a noxious extent in the country; while others are of opinion that it took its origin from some relation between its plumage and one of the phases of the moon; a third class ascribing it to the fact that its appearance announced the overflow of the Nile. For a long while, the African Tantal was believed to be the Ibis of the Egyptians, which is now ascertained to be a species of the division we are now treating of, the size of a Fowl, with white plumage, excepting the tips of the quill-feathers, which are black; the greater coverts [tertiaries] having elongated, slender, and loose barbs, of a black colour with violet reflections, and covering the extremities of the wing and tail. The beak and feet, together with the naked part of the head and neck, are black; and the latter clothed, in the young, at least the upper surface, with short black feathers.* It is found throughout Africa.

Other Ibises have scutellated tarsi, and generally a more slender bill.

The Scarlet Ibis (*Scol. rubra*, Lin.; *Tantalus ruber*, Gm.).—Remarkable for its bright-red colour all over, except the black tips of its wings. The young are at first covered with blackish down, becoming then ash-coloured, and whitish when they begin to fly: in two years the red makes its appearance, the brilliancy of which increases with age. It is found in the hot parts of America, and lives in marshy districts in the vicinity of estuaries; does not migrate, and is easily rendered domestic.

The Glossy Ibis (*Sc. falcinellus*, Lin.).—Body empurpled rufous-brown, with a deep green mantle; the young with the head and neck speckled with whitish. A resplendent species of the south of Europe and north of Africa, and probably that designated *Black Ibis* by the ancients. [It occurs rarely in the British Isles.]

THE CURLEWS (*Numenius*, Cuv.)—

Have an arcuated bill like that of an Ibis, but more slender, and round throughout; the tip of the upper mandible passing beyond that of the lower, and bulging a little downwards in front of it. The toes are palmated at base.

The Whaup Curlew (*Sc. arcuata*, Lin.).—Size of a Capon, and brown, with the margins of all the feathers whitish; the croup white, and tail barred white and brown. It is tolerably good eating, and common along our coasts, and as a bird of passage in the interior, [breeding in the upland moors of Britain: its plaintive whistle is well known along the sea-side, and has given rise to its name.]

The Whimbrel Curlew (*Sc. phæopus*, Lin.).—One half smaller, with nearly similar plumage. [Is not quite so common in Britain as the last, and breeds sparingly on our most northern hills. There are several others].

THE SNIPES, properly so called, (*Scolopax*, Cuv.),—

Have a straight bill, with the nasal grooves extending nearly to the tip, which expands a little externally to reach beyond the lower mandible, on the middle of which there is a simple furrow. The tip of the bill is soft and very sensitive, and drying after death presents a punctured surface. The feet are devoid of any palmature. A peculiar character of these birds consists in the compressed form of the head, and the backward site [at least in the larger species, with shorter tarsi], of their large eyes, which imparts a singularly stupid air, in conformity with their habits.

* We believe that all birds which have any naked parts in the adult state, have invariably the same feathered when young.—ED.

[They fall into two natural subdivisions: the first that of the Woodcocks, with less slender form, shorter legs, and the tibia feathered to the joint; colour resembling that of decayed leaves.]

The European Woodcock (*Sc. rusticola*, Lin.).—Universally known, with handsomely mottled plumage. In the summer it inhabits high mountains, and descends into the woods in the month of October, where it is generally met with singly or in pairs, particularly in dull weather, and feeds on worms and insects. A few remain in the level country throughout the year.

[The Snipes, commonly so called, are lighter-made, with longer legs, and tibia bare above the joint. They frequent marshy districts, and are coloured in adaptation to their abode.

In Britain, we have three species, very similar in their colouring,—the Great or Double Snipe (*Sc. major*), which approaches in form to a Woodcock, and is only met with in the seasons of passage; the Common or Whole Snipe (*Sc. gallinago*), which breeds in considerable numbers on the northern hills, and is everywhere common in marshy districts during the winter; and the Half or Jack Snipe (*Sc. gallinula*), a minute species, more richly coloured than the preceding, with much less tail: a fourth, the Sabine's Snipe (*Sc. Sabini*), is extremely rare, and exceeds the Common Snipe in size, having dingy plumage, with no white upon it. All are highly esteemed for the table.]

We should distinguish from the other Snipes

The Grey species (*S. grisea* and *Novoboracensis*: [*Macroramphus griseus*, Leach), which is in truth a *Tringa* with a longer bill than usual, similar to that of the Snipes, and retains the gregarious habits and seasonal changes of colouring of the true Sandpipers and Godwits.] Its front toes are semipalmated. This bird is common in North America and occurs as a rare straggler on this side of the Atlantic.

THE RHYNCHEANS (*Rhynchæa*, Cuv.)—

Are African and Indian birds, the mandibles of which are nearly equal, a little arched at the end, with the nasal grooves extending to the tip of the upper one, which has no third furrow. Their toes are not palmated. To the port of the Snipes, they conjoin more vivid colours, and are particularly remarkable for the ocellated spots which adorn the quill-feathers of their wings and tail.

They are found of different medleys of colour, which Gmelin brought together as so many varieties of one species (*Sc. capensis*), and which Temminck also believes to be the same at different ages. One perfectly distinct has, however, been received from Brazil (*Rh. hilarea*, Val.)

THE GODWITS (*Limosa*, Bechst.)—

Have a straight bill, sometimes a little arcuated upwards, and still longer than in the Snipes, the nasal groove extending almost to the tip, which is rather soft and depressed, but without additional furrow, or punctation. The external toes are palmated at base. Their form is much more attenuated, and legs considerably more elevated, than in the Snipes, and they frequent salt marshes and the shores of the ocean [changing to rufous on the under-parts and partially above in the breeding season, as in many Sandpipers, to which their gregarious habits are more nearly related than to those of the Snipes.

Two species are not uncommon on the British shores, viz., the Bar-tailed Godwit (*L. rufa*), which breeds more to the north, and abounds during the seasons of passage, and throughout the winter; and the Black-tailed Godwit (*L. melanura*), which is much taller, with a longer bill, and (in old specimens) a pectinated middle claw; the distal half of its tail is black, and it does not acquire so bright a rufous in the spring. This bird breeds in the British marshes, and can pick up and subsist on barley, upon which numbers are fed that are brought from Holland to the London markets. There are several others.]

THE SANDPIPERS (*Calidris*, Cuv.; *Tringa*,* Tem.)—

Have the tip of the beak depressed, and the nasal furrow very long, as in the Godwits, but the mandibles in general are not longer than the head; their toes, slightly bordered, have no palmation at the base, and the back-toe hardly reaches to the ground; their legs but moderately elevated, and abbreviated form, impart a heavier carriage than that of the Godwits. Their size also is much smaller. [The author separates his group *Pelidna*, merely on the character of having the beak a trifle longer than the head, a difference which in several species depends merely on age or sex; the females of all the present family having a proportionally longer beak than the males, besides exceeding them a little in stature.

Numerous species are found, more or less regularly, on the British shores: the principal of which are—the Knot Sandpiper (*Tr. canutus*), the size of a Snipe, and ashy-grey above, white below, with some dusky spots on the breast in winter, suffused with bright ferruginous in the spring; bill short and straight; it is a common species, and occurs in large flocks during the seasons of passage and through the winter, retiring further north to breed. The Purple Sandpiper (*Tr. maritima*), is smaller and less gregarious, and prefers rocky shores; back empurpled, the feathers margined with greyish during the winter. The rest are placed by the author in his *Pelidna*. The Purre Sandpiper (*Tr. variabilis*), still smaller, with a rather longer and more arcuated bill, coloured in winter like

* The latter name is generally adopted.—ED.

the first, and mottled with rufous above, and a black patch across the breast, in the breeding season: it is the commonest of all, and some breed on the upland moors. The Curlew Sandpiper (*Sc. subarquata*, Gm.; *Numenius africanus*, Lath.), resembles the Knot in colouring and seasonal changes, and the Purre in size, with a still longer and more-arcuated bill; it is not common, nor very rare, on the British shores. The Little Sandpiper (*Tr. minuta*) is considerably less than the last, with a short bill; it acquires some rufous tints in the spring, on the upper parts and across the breast, and is certainly rare, though very much overlooked. Three or four others occur as stragglers. These active little birds take their food along the margin of the sea, following each retreating wave; when gregarious in considerable flocks, and in their winter plumage, the whole show alternately their grey upper parts and white lower parts as they whirl in the air, producing a remarkable appearance, well known to those accustomed to wander by the sea side.]

THE SANDERLINGS (*Arenaria*, Bechst.; *Calidris*, Vigors)—

Merely differ in the absence of hind-toe, like the Plovers.

One only is known (*Charadrius calidris*, Gmelin), the size of a Purre, with analogous seasonal changes to those of the Knot Sandpiper. [It appears to be almost generally diffused, and is common on the British shores.]

THE FALCINELLES (*Erolia*, Vieillot)—

Have the beak rather more arcuated than in the Curlew Sandpiper, but do not, as has been asserted, want the thumb.

We are acquainted with one only, (*Sc. pygmæa*, Lin.), a bird proper to Africa, but which is occasionally found in Europe.

THE RUFFS (*Machetes*, Cuv.)—

Are true Sandpipers by the bill and feet, except that the palmature of their outer toes is nearly as considerable as in the Gambets, Godwits, &c.

One species only is known (*Tr. pugnax*, Lin.). Larger than a Snipe, and very celebrated for the furious combats which the males wage in spring for the possession of the females. At this epoch, the head becomes partly covered with red [or yellow] papillæ, and the neck is furnished with a very considerable collar or ruff of lengthened feathers, so variously marked and coloured in different individuals, that two can hardly ever be found alike, and rarely much resembling each other. They have always yellow legs*, which, together with the semi-palmation of the toes, assists us to recognize them at all seasons. The species is common in the north of Europe, [and is remarkable for the male exceeding the female in size, at variance with the other members of this group, but in accordance with its polygamous habits. Vast numbers are brought from Holland to the London markets.]

America produces some species nearly allied, as the *Hemipalamus*, Bonap.; or *Tringa semipalmata*, Wilson; [the habits of which are more allied to those of the Gambets, to which in fact they essentially belong].

Near the Sandpipers should apparently be placed

THE SPATHE-BILL (*Eurinorhynchus*, Wilson),—

Which is distinguished by a depressed bill, widened at the tip somewhat as in the Spoonbills, and the only species of which is

The *Platalea pygmæa*, Lin.; *Eurinorynchus griseus*, Wilson (*Thun. Acad. Suec.*, **1816**, pl. vi), which is one of the rarest birds in existence, as it is only known by a single individual, grey above and white beneath, and about the size of a Purre Sandpiper. [It has since been met with in northern Asia.]

THE PHALAROPES (*Phalaropus*, Brisson),—

Are small birds, the bill of which, more flattened than in the Sandpipers, is otherwise similar as regards its proportions and lateral grooves, and the toes of which are bordered with very broad membranes, as in the Coots. [Their lower plumage resembles in texture that of the Gulls.]

The known species (*Tr. lobata* and *Tr. fulicaria*, Lin.), has a wide bill for a member of this family, and is in winter ash-coloured above, whitish below and on the head, with a black band upon the neck: it is then the *Grey Phalarope* (*Tr. lobata*, Edw.). In summer it becomes black, mottled with fulvous above, and of a deep reddish below [like the Knot Sandpiper, Godwits, &c.]: but at all seasons it retains a white spot on the wing, the rest of which is blackish. It is then the *Red Phalarope* (*Ph. rufus*, Bechstein and Meyer; *Tr. fulicaria*, Lin.). This bird is rare in Europe [not very so in the British Isles, during the season of passage, when individuals are occasionally met with swimming upon inland ponds, like a very diminutive Duck, and evincing little fear or shyness: they also occur in small flocks, and breed chiefly within the Arctic circle].

THE TURNSTONES (*Strepsilas*, Illiger),—

Are rather lower on the legs, and have a short bill, and toes devoid of any palmature, like the true Sandpipers; but their beak is conical, pointed, and without depression, compression, or inflation, and the nasal groove reaches only half-way. The thumb barely touches the ground. Their beak, rather

* This is very far from being the case.—ED

stouter and proportionally less flexible than in the preceding, is used by them to turn over stones to search for the worms that lie beneath them. [Its form is not unlike that of a Nuthatch's bill.]

The two species doubtfully indicated by the author are merely the same in different states of plumage: it is a bird of remarkably wide geographic range, and tolerably plentiful on the British coasts: its affinity is rather with the Oyster-catchers and Plovers].

THE GAMBETS (*Totanus*, Cuv.)—

Have a slender, round, pointed, and solid beak, the nasal groove of which only extends half its length, and the upper mandible is slightly arcuated towards the tip. Their form is slight, and legs elevated: the thumb hardly touches the ground, and the palmation of their outer toe is well-marked. The species are each found nearly all over the world, [or rather, there are many difficult of determination apart, which has induced the latter opinion.]

The Greenshank Gambet (*Scol. glottis*, Lin.).—As large as a [rather small] Godwit, with the beak comparatively stout, [and a little recurved]; ashy-brown above and on the sides, with the margins of the feathers punctated with brown, the croup and belly white, and tail rayed with narrow irregular bars grey and white; the feet green: in summer the throat and breast are spotted with dusky tears, which disappear after the breeding season. This is the largest species of Gambet in Europe. [It breeds on the margins of lakes, including those of Britain, and during the season of propagation is very clamorous, rising on the wing and spreading an alarm at the approach of danger to all other birds within hearing: in winter it resorts to the sea-shore in small flocks, apparently the amount of broods. The Greenshank is a characteristic example of a particular group, the members of which are comparatively large, acquire more or less of a dusky colour on the under-parts towards the breeding season, and agree in their general habits, mostly frequenting fresh-water lakes. An allied species of North America (*Tot. semipalmatus*) has the toes half-webbed, and has been known to occur in Europe as a straggler. The Dusky Gambet (*T. fuscus*) is another European species, more delicately formed, with particularly slender beak and feet, and beautifully barred tail and coverts, which becomes entirely suffused on the under-parts with fuliginous-black in the spring, and is rare in Britain. A fourth (*T. calidris*), the Redshank Gambet, is very abundant in Britain, breeding also not uncommonly in marshes near the sea-shore, and especially about the estuaries of rivers.

Others acquire no colour on the under-parts in spring, and mostly breed in the marshes, where they trip across the broad floating leaves of aquatic plants with grace and agility: such are, particularly, those with longer legs, as the delicate Wood Gambet (*T. glareola*), which is sometimes found in Britain, the *T. stagnatalis*, Bechst., of eastern Europe, and *T. chloropygius* of North America: one more common in this country, with shorter legs, and a conspicuous white rump as it flies, is the Green Gambet (*T. ochropus*), which conducts into the next minor group.

The others, at least those of Europe, are still smaller, and familiarly known as *Summer Snipes* in England. One very common may be termed the Common Gambet (*T. hypoleucos*), which in America is represented by a species with a breast spotted like that of a Thrush (*T. macularia*). Another in Europe, still more diminutive (*T. Temminckii* or *pusilla*), has been generally classed with the Sandpipers, but strictly appertains to the present group both in structure and habits, being never found on the sea-shore, but frequenting inland waters like its true congeners, all of which jerk the tail and nod the head frequently as they run about, and emit a clear whistling note. There are many others in foreign parts.]

THE LOBEFOOT (*Lobipes*, Cuv.),—

Which we consider ought to be separated from the Phalaropes, which it resembles in the lobation of its toes, is distinguished from them by its bill, which is that of a Gambet. Such is

The Red-necked Lobefoot (*Tringa hyperborea*, Lin.).—A little bird, grey above, white below, tinted with rufous on the scapularies, and having a broad red gorget round its white throat. Add the *Phalaropus frenatus*, Vieillot; or *Holopodius* [*Wilsonii*] of M. C. Bonaparte, [which is found in America generally. The first-named species breeds in the northern isles of Scotland, inhabiting marshy grounds, where it cannot be obtained without much difficulty, though far from being timid in its disposition].

THE STILTS (*Himantopus*, Brisson)—

Have a round beak, slender and pointed, even more so than in the Gambets; the grooves of the nostrils extending only half-way. But what particularly distinguishes them, and has given origin to their name, is the inordinate length and slenderness of their legs, which are reticulated and destitute of hind-toe, and the bones of which are so feeble as to render walking painful to them.

Fig. 121.—The Stilt

But one species is known in Europe (*Charadrius himantopus*, Lin.; [*H. Plinii*, Auct.]; which is white, with a black calotte and mantle, and long red legs. It is rather rare, and little is known of its manners. [The latter

bear a near resemblance to those of the Avocets, with which this genus is even linked by an intermediate species, which conjoins the webbed toes of the latter with the beak of the Stilts (the *H. palmatus*, Gould, a native of Australia). There are three or four normal species, and both this and the next genus are almost generally diffused, frequenting muddy estuaries in winter, and salt-marshes during the season of propagation].

We can scarcely place otherwise than here

THE AVOCETS (*Recurvirostra*, Lin.),—

Although their feet, which are webbed nearly to the ends of their toes, almost entitle them to rank among the Swimming-birds; but their lengthened tarsi and half-naked tibiæ, their long, slender, pointed, smooth, and elastic bill, and the mode of life which results from their conformation, concur to approximate them to the Snipes. What particularly characterizes them, and distinguishes them even from all other birds [if two remarkable species of Humming-bird be excepted, the *Trochilus recurvirostra* and *Tr. avocetta*], is the strong upward curvature of their beak, [the mandibles of which have often been compared to two thin slips of whalebone]. Their legs are reticulated, and thumb too short to reach the ground.

That of Europe (*R. avocetta*, Lin.) is white, with a black calotte and three bands of the same upon the wings, and leaden-coloured legs. It is a handsome bird, of attenuated form, which frequents the sea-shore in winter, [where it feeds by *scooping* (as it is termed), with its singular bill, drawing this through the mud or sand from right to left as it advances its left leg foremost, and *vice versâ*, seizing whatever living prey is thus met with. Its manners in the breeding season resemble those of the Gambets, rising on wing and emitting its cry at the approach of any intruder; it collects, however, a greater quantity of nest than is usual among the wading-birds, the majority of which pertaining to the present group merely lay in some slight hollow. There are three or four other species].

The family of

MACRODACTYLI

Are furnished with very long toes, adapted for traversing aquatic herbage, or even for swimming, in those numerous species which have them bordered, [and not these only]. There are no membranes, however, connecting the bases of their toes, not even the two outer ones. The beak, more or less laterally compressed, is lengthened or shortened according to the genus, without ever attaining the degree of feebleness and attenuation which is characteristic of the preceding family. The body of these birds is also singularly compressed, a conformation resulting from the narrowness of the sternum (fig. 122); their wings are short or moderate, and their flight feeble. [The females are mostly larger, and in some instances excel the males in brightness of colouring; and they produce numerous speckled eggs, having a reddish clay ground-colour, the young running soon after they are hatched, being then covered with a rigid, black, hair-like down: their cry is generally abrupt and croaking].

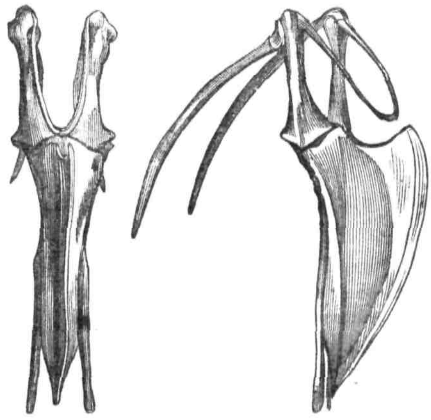

Fig. 122.—Sternum of Corn Crake or Land Rail.

They have been divided into two tribes, according to the presence or absence of any armature on the wings; but this character is subject to exception.

THE JACANAS (*Parra*, Lin.)—

Are conspicuously distinguished from all other Stilt-birds by the extraordinary length of their four toes, which are separated to the base, and the claws of which, more particularly that of the back-toe, are extremely long and sharp-pointed. The bill resembles that of the Lapwings by its medium length and slight bulge towards the tip, and the wing is armed with a spur. They are noisy and quarrelsome birds, which reside in the marshes of hot climates, where they walk with facility on the floating leaves of aquatic plants, by means of their long toes. [They are essentially modified, however, upon the type

We terminate this series of Stilt-birds by three genera, which it is difficult to associate with any others, and which may be considered as each forming a separate family.

THE SHEATHBILLS (*Chionis*, Forster)—

Have short toes, nearly as in the Poultry, the tarsi scutellated, the beak thick and conical, and enveloped at base by a hard substance, which, it appears, the bird has the power of raising and depressing.

We are acquainted with only one species, from New Holland (*Ch. necrophaga*, Vieillot), the size of a [large] Partridge, and entirely white. It frequents the sea shore, and feeds on dead animal matter thrown up by the tide. [Prof. Blainville has lately shown that this remarkable bird approaches very near to the Oyster-catchers in its whole anatomy, and the affinity is discernible on comparison of their external characters.

Apparently allied are

THE ATTAGENS (*Attagis*, d'Orb.),—

The uncompressed bill of which nearly resembles that of a Poultry-bird, and the plumage is not unlike the immature dress of a Lark: wings and feet as in *Chionis*.

Several species inhabit the Cordilleras of the Andes, varying in size from that of a Partridge to less than a Lark. The smaller constitute the *Tinochorus* of Vieillot.]

THE PRATINCOLES (*Glareola*, Gmelin)—

Have a short, conical beak, arcuated throughout, and resembling that of a Poultry-bird. The wings excessively long and pointed, and tail often forked, producing the flight of a Swallow or Petrel. The legs are of mean length, the tarsi scutellated, the external toes a little palmated, and thumb reaching to the ground; [middle claw furnished with an obtusely serrated inner edge]. They fly in troops, and cry about the borders of water, subsisting on aquatic insects and worms. [Their sternal apparatus and anatomy intimate their position to be among the Snipes and Plovers.]

The European species (*Gl. torquata*) is brown above, white below and on the croup; the gorget encircled with a black marking; and base of the bill and feet reddish. It appears to inhabit the north of the whole ancient world.

Our last genus consists of

THE FLAMINGOES (*Phœnicopterus*, Lin.),—

Which are among the most extraordinary and isolated of birds, [being, in fact, an extreme modification of the Lamellirostral type, that is, of the Duck tribe, with inordinately elongated neck and legs]. Their legs, of excessive length, have their front toes palmated to the ends, and an extremely short hind-toe; the neck is equally long and slender with the legs, and their small head is furnished with a bill the inferior mandible of which is of an oval form, longitudinally bent into a semicylindrical canal, while the upper one, oblong and flat, is bent crosswise in the middle, so as to join the other exactly. The membranous groove of the nostrils occupies nearly the whole side of that part which is behind the sudden bend of the mandibles, and the nostrils themselves form a longitudinal slit at the base of the groove. The edges of the two mandibles are furnished with small and very fine transverse laminæ, which, together with the fleshy thickness of the tongue, imports some relationship with the Ducks. We might even place the Flamingoes among the *Palmipedes*, were it not for the length of their tarsi, and the nudity of part of the tibia, [an objection which would equally apply to the Gulls and Petrels]. They feed on Testaceans, Insects, and the spawn of Fishes, which they seize by means of their long neck, reverting the head to employ with advantage the crook of the upper mandible. They construct their nest of earth in marshy situations, placing themselves astride of it [?] during the act of incubation, in consequence of the extreme length of their legs incapacitating them from sitting in the usual manner. [The digestive organs resemble those of the Ducks with unlobated hind-toe; having even the *crop*, or distension of the œsophagus, which occurs in no species strictly belonging to the division of Stilt-birds.]

The common species (*Ph. ruber*) stands from three to four feet in height, and is ash-coloured, with brown streaks, during the first year; in the second there is a roseate hue on the wings, and in the third it assumes a purple red on the back, and rose-coloured wings. This species is found in all parts of the eastern continent below 40 degrees. Numerous flocks are seen every year on the southern coasts of Europe, and they sometimes ascend as far as the Rhine.

M. Temminck thinks [and has since definitively ascertained] that the American Flamingo is distinct; besides which, there is a small species on that continent (*Ph. minor*, Vieillot) of which the Pigmy Flamingo of Temminck is the young.

[Here, at the close of the great series of *Ground-Birds*, as of the *Perchers*, may be introduced a few brief remarks on the classification of these animals, as warranted by the present state of information. The divisions are not all so strongly characterized apart as the four principal groups or orders already specified; but chiefly because certain genera stand forth from the rest, and will not (so far as we can perceive at present) satisfactorily range with any of the others. Preserving the same form of nomenclature as before adopted, as less objectionable than any other that we can devise, the various groups of Ground-birds (as the vast majority of the foregoing extensive series may be appropriately denominated,) fall into six principal divisions, which may be designated as follow: —

V. GEMITORES (*Cooers*)—the Pigeons; an order strongly characterized by the whole internal anatomy, and not less so by the outward conformation. It is perfectly distinct from the contiguous orders, to which it is linked by no intrinsically connecting species.

VI. RASORES (*Ground-scratchers*)—the Poultry: a group sufficiently cognizable in its totality, but not easy to subdivide in such a manner as to exemplify the relative value of its various genera.

VII. CURSORES (*Runners*); or the *Brevipennes* of Cuvier.

VIII. CALCATORES (*Stampers*); or the *Pressirostres* and *Longirostres* of our author, comprising the numerous genera with soft and flexile bills, more or less prolonged, the greater number of which lay four eggs, which they dispose crosswise, &c. &c. The name alludes to the habit which many of them display, of stamping with the foot, to cause the worms on which they feed to rise.

IX. GRADATORES (*Stalkers*); or the *Cultrirostres* of Cuvier.

X. LATITORES (*Skulkers*); or the *Macrodactyli*.

Each of these appears to us to constitute a distinct and natural order, possessing various distinguishing characters; and we suspect that every genus of Ground-birds will ultimately prove, when its characters have been sufficiently studied, to rank in one or another of them. As a whole, they form a series, analogous to those of the *Perchers* and *Swimmers*.]

THE SIXTH ORDER OF BIRDS,—

THE PALMIPEDES,—

Have the feet organized for swimming; that is to say, placed far backwards on the body, with short and compressed tarsi, and webbed toes. They are further characterized by a close and polished plumage, impregnated with oil, and by a quantity of down next to the skin, which protect them from the water in which they pass most of their lives. They are the only birds in which the neck is longer than the legs, which is sometimes the case to a considerable extent, for the purpose of enabling them to search for food in the depths below, while they swim on the surface. Their sternum is very long, affording a complete guard to the greater portion of their viscera, and having on each side [generally] but one emargination, or oval foramen, filled up with membrane. They have most frequently a muscular gizzard, long cœca, and a simple inferior larynx; which last is in one family, however, inflated into a cartilaginous capsule. [So many exceptions occur to the foregoing generalization respecting the stomach and cœca, that it might advantageously have been omitted.]

This order subdivides tolerably well into four families, of which that of

THE DIVERS (*Brachypteres*)—

Presents, in certain of its species, some [very superficial] tokens of relationship with the Gallinules. The position of their legs, which is farther backward than in any other birds, renders walking difficult, and obliges them to maintain, when upon land, an upright attitude. As the

greater number of them are also feeble flyers, and several are quite deprived of that faculty, in consequence of the shortness of their wings, they may be regarded as exclusively attached to the surface of the water: their plumage is particularly dense, and its surface frequently polished, presenting a silvery lustre. They swim under water by the aid of their wings, which are employed as fins. Their gizzard is tolerably muscular; the cœca of moderate length. They have only one special muscle on each side of their lower larynx. Such are

THE LOONS (*Colymbus*, Lin.),—

Which are characterized by a smooth, straight, compressed, and pointed bill, with linear nostrils; but require to be subdivided from characters derived from the feet [the entire skeleton, character of plumage, propagation, &c. &c.]

THE GREBES (*Podiceps*, Latham; *Colymbus*, Brisson and Illiger),—

Instead of ordinary webs between the toes, have the latter widened as in the Coots, and the anterior connected only at base by membranes, [which border the remainder]. The claw of the middle toe is flattened; the tarsi exceedingly compressed. The semi-metallic [or satiny] lustre of their lower plumage has led to the occasional employment of it as fur. Their tibia, as also that of the Loons [in which it is much more produced,] is prolonged forwards beyond the joint, to give a more efficient insertion to the extensors of the leg. [Sternum (fig. 123)* very short, and of peculiar conformation, approaching in some respects to that of the Cormorants; which these very singular birds also resemble in the character of their eggs, the hard shell of which is invested with an absorbent chalky substance. They have no vestige of a tail. The young are clad in exquisitely soft down, which is striped black and white, as in the Emeu. The constant number of cervical vertebræ is nineteen instead of thirteen, as in the restricted Loons; and their skeleton is altogether extremely different.]

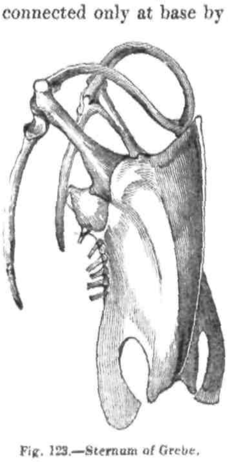

Fig. 123.—Sternum of Grebe.

These birds reside in lakes and ponds, and nestle among the rushes, [producing numerous eggs, whereas the Loons lay very rarely more than two]. It appears that under certain circumstances they carry their young under their wings. Their size and plumage change so much with age [the latter rather according to season], that naturalists have very much multiplied the species. M. Meyer reduces those of Europe to four, [instead of five, which is the right number, as follow]:—

The Crested Grebe (*P. cristatus*).—As large as a Duck, and satiny-white, with dusky upper-parts, acquiring with age a double black crest, and rufous collar edged with black, [which exist only during the breeding season].

The Red-necked Grebe (*P. rubricollis*).—Smaller, with the neck bright rufous, and greyish collar less developed.

The Horned Grebe (*P. cornutus*) [and Eared Grebe (*P. auritus*).—Still less, and precisely of the same size with each other, so that they can only be distinguished, when the seasonal collar falls, by the beak of the second being distinctly a little recurved, and by a difference in the colour of the iris of the recent specimen; their collars, however, during the breeding season, are very different, and that of the Eared Grebe is less developed than in the other].

The Little Grebe (*P. minor*).—Size of a Quail, with never any crest or collar. [These various species, notwithstanding the shortness of their wings, can fly with considerable speed, when they once fairly rise, which they do with unwillingness, and seldom except when compelled to migrate. They can walk with their feet, and do not trail upon the belly, like the Loons; and when under water, they make more use of their wings than the latter do habitually].

THE FINFEET (*Heliornis*, Bonaterre; *Podoa*, Illiger)—

Have feet lobed as in the Coots and Grebes, but their tail is more developed than in either, and their claws sharper.

Such is *Plotus surinamensis*, Gmelin; and *Heliornis senegalensis*, Vieillot, which Gmelin approximated to the Anhingas.

THE LOONS (*Colymbus*, Latham; *Mergus*, Brisson; *Eudytes*, Illiger),—

With all the [external] form of the Grebes, have the feet webbed in the ordinary manner; that is to say, their three front toes are connected by membrane to the tips, and are all terminated by

* The representation (fig. 123), in other respects accurate, is somewhat too long.—ED.

pointed nails. They are northern birds, which rarely nestle with us, and visit these latitudes in winter, when they are not uncommon upon our coasts. [They have large wings, and fly strongly, but in consequence of the position of the feet, the tibia being quite buried within the integuments, are unable to walk, though they push themselves forward with facility and tolerable speed, trailing upon the belly. They have a short tail, on the tripod of which and the feet they are enabled to stand upright, and take a wide view around them by means of their long neck: tney utter dismal howlings; and produce large spotted eggs, two or three in number, which are extremely unlike those of the Grebes.

Three species are well known, the whole of which are not rare in Britain. One, as large as a Goose (*Col. glacialis*), the Collared Loon, black above, beautifully spotted with white, with a nearly perfect collar of the same round the neck, and a black head. The second, (*C. glacialis*), the Black-throated Loon, extremely variable in size, but always smaller than the preceding, with a fuliginous grey head, and larger white spots on the upper parts: both of which species have the immature plumage dusky above, with greyish edgings to the feathers: and the Red-throated Loon (*C. septentrionalis*), still smaller and much commoner, the winter dress of which (and not the immature plumage, which resembles that of the others, is speckled above with numerous small whitish spots bordering the feathers, which wear off in spring, leaving the back spotless blackish; coincident with which change of appearance, a rufous patch appears in front of the neck. All three are great destroyers of fish, and proceed with extreme swiftness under water, in general making little use of their wings to assist their progress. They are common to the northern regions of both continents, as are also the four first-mentioned Grebes.]

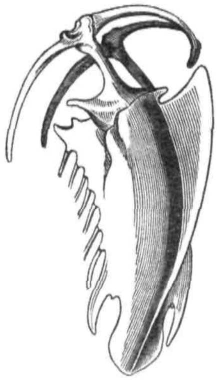
Fig. 124.—Sternum of Loon.

THE GUILLEMOTS (*Uria*, Brisson & Illiger),—With the general form of the beak of the preceding, have it covered with feathers as far as the nostril, and emarginated at the tip, which is a little arcuated. Their principal distinction, however, consists in wanting the back-toe. Their wings, much shorter than those of the Loons, barely suffice for the function of flying. They feed on fish and crustaceans, and are found about the precipitous rocks on which they breed.

[These birds, the first of which is merely an Auk with a more slender bill, fly with considerable swiftness in a straight line, their wings being reduced to the minimum extent adequate for aerial support, in order that thev might be more efficient under water, where no use whatever is made of the feet, which are held out like those of a wading bird when cleaving the air. Accordingly they literally fly under water, whereas the subaquatic progression of a Grebe more resembles that of a Frog, and the Loons do not generally use the wings at all: hence the prolongation forward of the fixed patella, so considerable in the Loons, which is reduced in the Grebes, and entirely wanting in the Auks, Puffins, and Guillemots, which form a particular group, found only in the ocean. The latter have also smaller cœca, a particularly tough cuticular lining to the stomach, of a bright yellow colour, a different sternal apparatus, which most nearly approximates that of the Loons, diverse plumage and seasonal changes, &c. They are pre-eminently remarkable for the manner in which the skeleton incloses the viscera as in a box, in order to resist the pressure of deep water; while their air-cavities are unusually large, which causes them to float very high when on the surface, and are obviously designed to increase the standard of respiration so as to permit of their sustaining themselves in the air with their short and narrow wings, these, however, not being violently beaten in the act of flying. Their movements under water precisely resemble those of the *Dyticidæ*, or common Water Beetles; the principal motion being more or less vertical, instead of horizontal as in the Grebes and Loons: they are, therefore, together with the distinct group of Penguins, the most characteristic *divers* of the class.

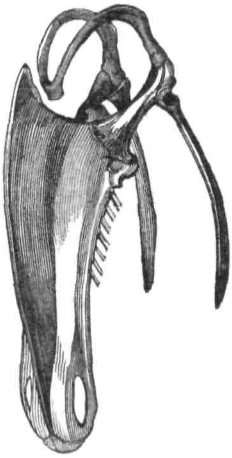
Fig. 125.—Sternum of Guillemot.

One common on the precipitous coasts of all Britain, is the Common Guillemot (*U. troile*), of a dusky slate-colour above, white beneath, and a bar of the same on the wing, formed by the tips of the secondaries; the throat black in summer, white in winter. It lays only one egg, of enormous proportional magnitude, and remarkably variable in colour. The young at first resemble the adults in summer dress; but their first plumage, which succeeds the down, and the texture of which is singularly delicate, presents the colouring of the adult winter-garb, and is exchanged for the latter in the course of a few weeks. They breed in vast numbers on the narrow ledges of rocks, where in many places they are seen sitting in successive rows, one over another. In autumn they migrate southward, those which breed on the British shores being replaced by others from more northern latitudes.

Another and smaller species, is the Black Guillemot (*U. grylle*), entirely black, with a great white wing-spot, in

summer, and everywhere mottled with white in winter: the bill and feet red. Its range is more northerly, rarely if ever breeding to the southward of the Scottish Isles, and producing two and often three eggs, proportionally smaller, and singularly different from those of the other, both in shape and colour. It is less allied to the Common Guillemot than the latter is to the Auks, with which an intermediate species, rarely found on the British coasts, tends even to connect it,—the *U. Brunnichii*, which scarcely differs except in the more robust form of the bill. There is also a breed of the Common Guillemot found on the Welsh coast, and some other places, which has a narrow white line from the bill to the eye, as in the Razor-billed Auk.]

THE ROTCHE (*Cephus*, Cuv. [*Mergulus*, Ray and Vieillot]),—

Has a shorter bill, more arcuated above, and unemarginated; the symphysis of the lower mandible extremely short. Its wings are stronger, and the membranes of the feet somewhat notched.

The known species, termed *Little Auk* and *Greenland Dove*, (*C. alle; Colymbus minor*, Gmelin), is not larger than a Pigeon, and black above, white below, with the same mark on the wing as the Common Guillemot. It inhabits the arctic shores, where it breeds on the ground, and is occasionally met with in our latitudes during the winter.

The genus of

THE AUKS (*Alca*, Lin.)—

Is known by its extremely compressed beak, raised vertically, sharp along the ridge, and ordinarily grooved on the sides, together with its feet entirely palmated and without back toe, the same as in the Guillemots. The species are all from the northern seas.

They require to be divided into three subgenera.

THE PUFFINS (*Fratercula*, Brisson; *Mormon*, Illiger),—

Of which the beak, shorter than the head, is as high or higher than it is long, giving it a very extraordinary form, while its base is generally furnished with a folded skin. The nostrils, placed near its edge, are mere slits. Their short wings can just sustain them for a brief period, and they reside in the ocean like the Guillemots, and nestle in the rocks, [or rather they burrow holes in loose soil, and lay their single egg at the depth of several feet. They run or creep swiftly on the ground, and the Auks and Guillemots can also waddle with more speed than might be anticipated from the shortness of their legs].

The common species (*Alca arctica*, Lin.; *Mormon fratercula*, Tem.), is a little larger than a Pigeon, with black mantle, calotte, and collar, and the rest white. [Legs orange; bill brightly coloured; and a slip of loose skin at each eye. It is common in suitable localities on the British shores, flies rapidly, and may often be seen to return to its mate or young, with a number of small fishes curiously ranged on each side of its bill, each held by the head. The young are at first covered with long and flocculent black down, which is replaced by delicately soft plumage analogous to that of the young Guillemot, succeeded by the adult garb in the course of a few weeks, which last undergoes no seasonal changes].

M. Temminck distinguishes as

THE PHALERINS (*Phaleris*, Tem.),

Those species which have the beak less elevated; as,

The *Alca cristatella*, Vieillot, and *A. psittacula*, Pallas. [Six species are known on the arctic shores of America, one forming the *Ceratorynchus*, Bonap.; some of these extend to the north of Siberia.]

THE RESTRICTED AUKS (*Alca*, Cuv.)—

Have a more lengthened beak, resembling the blade of a knife; feathers at its base as far as the nostrils, [the same as in the Guillemots, to which they are most nearly allied,] and wings decidedly too small to support them, inasmuch as they cannot fly at all; [an erroneous statement respecting one of the two species].

The Razor-bill Auk (*Alca torda* and *pica*, Gmelin). [Plumage and seasonal changes of the Common Guillemot, only that the black is more deep, and some white transverse lines on the bill. It is rather smaller than that species, which it exactly resembles in habit and extent of wing, flying equally well: inhabits the same cliffs, but less numerously; and commonly lays two eggs, sometimes three, of similar character to those of the Black Guillemot: has a croaking voice.]

The Great Auk (*A. impennis*, Lin.).—Colours of the preceding, but the beak marked with eight or ten cross grooves, and an oval white spot between the eye and bill. It lays but one great egg, spotted with purplish. [This species, which is larger than a Goose, is the only northern sea-fowl utterly deprived of the function of flight, and has accordingly its wings reduced to exactly that size which is most efficient of all for subaquatic progression: they are not larger than very moderate-sized fins, and the limb-bones are considerably weightier and less solid than those of its congener; but we are not aware that the skeleton makes any approach in form to that of the

Penguins of the southern hemisphere, which are very distinct from the Auks. As a particularly rare visitant, this species is allowed a place in the British Fauna.]

The genus of

THE PENGUINS (*Aptenodytes*, Forster)—

Is even less capable of flying than that of the Auks. Their little wings, covered with mere vestiges of feathers, which at the first glance resemble scales; their feet, placed farther back than in any other bird [the Grebes and Loons alone excepted,] only support them by bearing on the tarsus, which is widened like the sole of the foot of a quadruped, and in which are found three bones soldered together at their extremities. They have a small hind toe, directed inwards, and their three anterior toes are joined by an entire membrane. These birds are found only in the antarctic seas, never going on shore except to breed. They can only reach their nests by trailing on their bellies. The difference in the bill authorizes their division into three sub-genera.

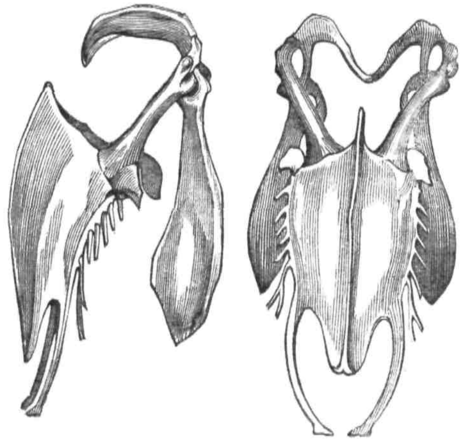

Fig. 126.—Sternum of Penguin.

THE PENGUINS, properly so called (*Aptenodytes*, Cuv.),—

Have a long, slender, and pointed beak, the upper mandible a little arcuated towards the tip, and feathered for about a third of its length; in this the nostril is placed, from which a groove extends to the tip.

The Patagonian Penguin (*Apt. patachonica*, Gm.).—Size of a Goose, and slate-coloured above, white underneath, with a black mark, encircled by a citron-yellow cravat. It inhabits the vicinity of the Straits of Magellan in large flocks, ranging as far as New Guinea. Its flesh, although black, is eaten.

THE GORFEWS (*Catarrhactes*, Brisson)—

Have a stout and pointed beak, somewhat compressed, with a rounded ridge, and tip a little arcuated; the groove which extends forward from the nostril terminates obliquely on the inferior third of its edge.

The Crested Gorfew (*Apt. chrysocoma*, Gm.).—Size of a large Duck, black above, white below, and adorned with a white or yellow crest on each side of the occiput. It is found in the vicinity of the Falkland Isles and of New Holland, and sometimes leaps out of the water while swimming. Deposits its eggs in a hole of the ground. There are several others.

THE SPHENISCANS (*Spheniscus*, Brisson)—

Have a straight and compressed beak, irregularly furrowed at the base; the tip of the upper mandible hooked, and of the other truncate; nostrils situate in the middle, and uncovered.

The Cape Spheniscan (*Apt. demersa*, Gmelin).—Black above, white below, the beak brown, with a white band in the middle, throat black, and a line of the same upon the breast, which is continued along each flank. It chiefly inhabits the neighbourhood of the Cape, where it nestles among the rocks. [Fig. 126 represents the sternal apparatus of this species, showing the peculiar configuration common to the group, and particularly the broad scapula. The bones of the Penguins are permanently filled with marrow.]

The family of

LONGIPENNES

Comprehends those Birds of the high seas, which, in consequence of their capability of protracted flight, are met with everywhere, [though it does not appear that the particular species are more widely diffused than others]. They are known by the freedom or total absence of the thumb, their very long wings, and smooth-edged beak, which in the greater number of genera is hooked at the tip, and in the others simply pointed. Their inferior larynx has only one muscle proper on each side, and the gizzard is muscular [or lax and very capacious], the cœca short [or moderate].

THE PETRELS (*Procellaria*, Lin.)—

Have the beak hooked at the tip, with its extremity appearing as though a piece had been articulated to

the rest; their nostrils are united to form a tube, which lies along the back of the upper mandible; and their feet, instead of a back toe, have merely a claw implanted in the heel. They are, of all the *Palmipedes*, those which remain most constantly at a great distance from land; and when a tempest comes on, they are often compelled to seek refuge on reefs and ships, from which circumstance they derive their name of *Storm-birds:* that of *Petrel* (a diminutive of *Peter*,) has been applied to them from their habit of walking on the waves, which they do with the assistance of their wings. They nestle in the holes of rocks, [producing but a single egg,] and spurt upon those who disturb them an oily fluid, with which their stomachs appear to be always filled. The greater number of species inhabit the Antarctic seas. [Their stomach is extremely capacious, and but slightly muscular, and they feed principally on oily substances.]

Those are more particularly called Petrels (*Procellaria*), the lower mandible of which is truncated.

The largest species, or Giant Petrel (*Proc. gigantea*), inhabits the Austral Seas, and exceeds a Goose in size. Its plumage is blackish, but with varieties more or less white. In the same seas is found

The Spotted Petrel (*Pr. capensis*).—Size of a small Duck, and white, spotted with black above. It is often mentioned by navigators [as the *Cape Pigeon*].

The Fulmar Petrel (*Pr. glacialis*).—White, with ash-coloured mantle, the bill and feet yellow, and size that of a large Duck. It nestles in the precipitous coasts of the [northern] British isles, and is found throughout the whole north. [It has been computed that this species is the most numerous in individuals of the whole class. Though rare in our latitudes, its numbers in the Arctic seas are inconceivable.]

THE STORM-PETRELS (*Thalassidroma*, Vig.)—

Are certain small species, with a somewhat shorter bill, rather longer legs, and black plumage, which are more particularly designated *Storm-birds* [and *Mother Carey's Chickens*] by mariners. [Their habits are crepuscular and nocturnal, as are also those of most of the tribe: and their flight considerably resembles that of a Swallow.]

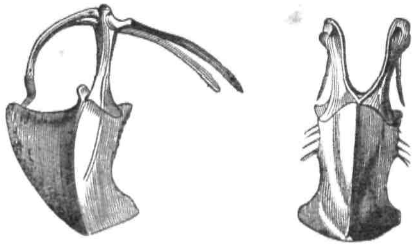

Fig. 127.—Sternum of Storm Petrel.

The most common (*Proc. pelagica*, Brisson) is scarcely larger than a Lark, but stands higher on the legs. It is entirely brown-black, except the croup, which is white, and there is a trace of white on the greater wing coverts. When this bird seeks a shelter upon vessels, it is a sign of an approaching storm. [That of America (*Ph. Wilsonii*) is distinct, and is sometimes met with on our shores; as is also a third species with a forked tail, *Th. Bullockii*. After tempestuous weather, these birds are not unfrequently found far inland, generally upon the high road, unable to rise].

We separate, with Brisson, by the name of

THE SHEARWATERS (*Puffinus*),—

Those species in which the tip of the lower mandible is curved downwards, like that of the upper, and the nostrils of which, although tubular, do not open by a common orifice, but by two distinct holes. Their beak also is proportionally longer.

The Cinereous Shearwater (*P. cinereus; Proc. puffinus*, Gm.)—Ash-coloured above, whitish beneath, with the wings and tail blackish; the young rather more deeply coloured. Its size is nearly that of a Crow, and it is found almost everywhere, [but rarely so far north as on the British shores].

A smaller species was long confounded with it, black above and white below, the Manks Shearwater (*P. anglorum*), which inhabits the northern shores of Scotland and its isles in immense numbers, and which the inhabitants salt for winter provision. [A third (*P. obscurus*, Vieillot) has occurred in Britain, and there are two or three more, further south.]

Navigators sometimes mention, under the name of Petrels, certain birds of the Antarctic seas, which should make two particular genera. One is

THE HALADROME (*Haladroma*, Illiger),—

Which, with the beak and form of the Petrels and Shearwaters, has a dilatable throat like the Cormorants, and entirely wants the thumb, as in the Albatrosses.

Such is *Pr. urinatrix*, Gmelin.

The other is

THE PRIONS (*Pachyptila*, Illiger),—

In other respects similar to the Petrels, have separate nostrils like the Shearwaters, and the beak widened at its base, its edges being interiorly furnished with fine, pointed, vertical laminæ, analogous to those of the Ducks.

These are the *Blue Petrels* (*Proc. vittata* and *cærulea*, Forster).

THE ALBATROSSES (*Diomedea*, Lin.)—

Are the most massive of all aquatic birds. Their large, stout, and trenchant beak, with strongly marked sutures, is terminated by a hook, which looks as if articulated. The nostrils resemble short rolls, laid on each side of the beak; and the feet have no hind toe, not even the little nail which is found in the Petrels. They inhabit the Austral seas, and feed on the spawn of Fishes, Mollusks, &c.; [indeed, upon whatever falls in their way. They pertain to the same particular group as the Petrels, which they resemble in their whole anatomy. Their webbed feet are equally large, and they have the same habit of trampling on the waves].

The species best known to navigators, or the Giant Albatross (*D. exulans*, Lin.), has been termed the *Cape Sheep* from its size, having white plumage, and black wings. The English also style it the *Man-of-War Bird*, [a mistake, as this term applies to the Tachypete]. It is particularly common beyond the tropic of Capricorn, and is the great enemy of the Flying Fish. This bird constructs a high nest of earth, and lays numerous eggs [each individual, however, one only, and generally in company with Penguins], which are esteemed good eating: its cry is very loud. There are three or four others, about two-thirds the size.

THE GULLS (*Larus*, Lin.)—

Have the bill moderately long, compressed, and pointed, the upper mandible arcuated towards the tip, and the lower forming a projecting angle beneath. Their nostrils, placed near its middle, are long, narrow, and pierced quite through, [the beak having little bony substance in comparison with those of the Petrels and Albatrosses]. Their tail is full, the legs tolerably elevated, and the thumb short. They are cowardly and voracious birds, which abound along the sea-shore, and feed on all sorts of fish, carrion, &c. They nestle in the sand or in clefts of rocks, and lay few eggs, [generally three in number]. When they come inland, bad weather may be expected. Several species of them are found on our coasts; and as their plumage varies exceedingly with age, they have been further multiplied by systematists. In general, during youth, they are mottled with greyish. [These birds have a capacious gullet, and small gizzard, which becomes more muscular with age. Their general anatomy is considerably allied to that of the *Calcatores*, or Snipes and Plovers. Their toes are shorter than in the preceding genera, and the feet better fitted for walking on land.

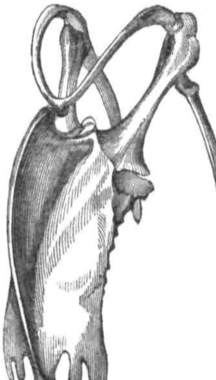

Fig. 128.—Sternum of Gull.

Those of Britain are—the Great Black-backed Gull (*L. marinus*), white, with a black saddle; bill four inches long, and with the orbits yellow; of common occurrence: the Glaucous Gull (*L. glaucus*), with a very pale silvery saddle, and entirely white quills, from which we do not regard the Iceland Gull (*L. islandicus*, Auct.), of Europe, as distinct, having obtained intermediate specimens of every grade of size; it is rare on the coasts of South Britain: the Herring Gull (*L. argentatus*), the commonest of all, differing from the first chiefly in its inferior size and ash-coloured mantle: the Lesser Blackbacked Gull (*L. fuscus*), somewhat less than the Herring Gull, and similar to the first, but not so deeply coloured, and having yellow legs instead of flesh-coloured, and red orbits; which is rather common: the Mew Gull (*L. canus*), a diminutive of the Herring Gull, with white legs: the Kittiwake Gull (*L. rissa*), rather smaller still, and at once distinguished by the total absence of hind-toe; both of these being common in particular localities: and the Ivory Gull (*L. eburneus*), the adult plumage of which is wholly pure white, contrasting with black feet, and which is only an occasional straggler in the British seas. All these are, for the most part, rock-builders.

Others, the *Xema* of Leach, have a black hood in summer, like the Terns, and are generally slighter-made, breeding chiefly in marshes. The commonest in Britain is known as the Hooded Gull (*L. ridibundus*), with the head and upper neck brownish-black during the breeding season, and bill and legs bright vermilion: the Masked Gull (*L. capistratus*) is rather smaller, with the hood considerably reduced, and is not common: *L. atricilla* is larger than either, with a stouter bill, and black legs; also very rare: *L. Sabini*, smaller than the Masked Gull, is at once distinguished by its forked tail, and is met with occasionally in Ireland and the west of Britain: and *L. minutus*, the smallest of all, not exceeding ten inches in length, and equally uncommon upon the British shores, is known by its size. There are many more, of both divisions.]

From the Gulls have been very properly separated

THE SKUAS (*Lestris*, Illiger),—

The membranous nostrils of which, larger than in the preceding, open nearer to the point and edge of the beak; the tail also is pointed, [and they have great cœca]. They eagerly pursue the smaller Gulls to rob them of their food, and, as has been said, to devour their excrement; [the truth being, that they cause them to disgorge, whereupon they seize the food before it reaches the water, being endowed with uncommon power of flight]: hence their name, [*Lestris*, or robber.

Four species occur on the British shores, successively smaller, with the middle tail-feathers prolonged in the same ratio. The largest (*L. cataractes*), nearly the size of the Great Black-backed Gull, has deep brown plumage, with the middle tail-feathers but slightly elongated. It breeds on certain of the northern Scottish isles, high upon the mountains, defending its nest with extraordinary spirit and intrepidity, and furiously driving off Eagles from the vicinity, for which reason it is protected by the inhabitants, as a guard to their flocks. The Pomarine Skua (*L. pomarinus*) is smaller, and though generally exceedingly rare, makes its apearance in certain seasons in considerable numbers, as in the instance of November, 1837. *L. Richardsonii* is the next in size, which is common about the northern Scottish isles; and *L. parasiticus*, the smallest, which belongs more properly to America, has exceedingly long middle tail-feathers. The females of these birds are larger than the males, which is the reverse of what is observable in the Gulls; and they lay but two eggs, of a dark colour].

THE TERNS (*Sterna*, Linn.)—

Are termed *Sea-swallows*, from their extremely long and pointed wings, their forked tail, and short legs, which induce a port and flight analogous to those of the Swallows, [the true Terns, however, *winnowing* more in the manner of the Gulls]. Their beak is straight, pointed, and compressed, without curvature or projection; having the nostrils near its base, oblong, and pierced quite through. The membranes which connect their toes are deeply emarginated, and they swim little, [if at all]. They fly in every direction and with great rapidity, uttering loud cries, and skilfully raising from the surface of the water mollusks and small fishes, upon which they feed, [and to obtain which they often plunge]. They also penetrate to the lakes and rivers of the interior. [Their anatomy precisely accords with that of the Gulls, as do also the character of their plumage, their seasonal and progressive changes, mode of propagation, eggs, &c.

The British species fall into two principal groups; the majority having the same black calotte in spring as the *Xema* Gulls. The commonest (*St. hirundo*) has an ashy mantle, red feet, and the bill red with a black tip. The Arctic Tern (*St. arctica*), common along our northern coasts, is rather smaller, with shorter legs, and under-parts tinged with ash-colour. The Little Tern (*St. minuta*) is distinguished by its very inferior size, and white forehead. The Sandwich T. (*St. cantiaca* and *Boysii*) is larger than any of the foregoing, with black feet, and often a tint of roseate on the breast. In the Roseate T. (*St. Dougalli*), the same tinge is brighter, and the feet are orange. The Gull-billed T. (*St. anglica*) has the bill prominent at the symphisis, as in the Gulls; but notwithstanding its received systematic name, is extremely rare in Britain. The Caspian T. (*St. caspia*), occasionally met with in the Channel, is very considerably larger than any of the others. The two last are principally marsh Terns; and the most characteristic of these is the Black Tern (*St. nigra*), with tail less deeply forked than in the others, membranes of the feet more reduced, and smaller bill, which subsists chiefly on insects taken on the wing, and flies more like a Swallow. There are numerous others.]

We might distinguish from the other Terns,

THE NODDIES (*Megalopterus*, Boié),—

The tail of which is not forked, [but the reverse,] and even with the wings; and the bill has a slight salient angle, the first indication of that in the Gulls; [whilst the character of the plumage resembles that of a Petrel, and the feathers are not continued forward to the nostrils]. We only know of one,—

The Black Noddy (*Sterna stolida*, Lin.).—Brown black, the front of the head whitish. It is well known to seamen for the stupidity with which it throws itself on vessels [and allows itself to be taken. Is one of the most widely distributed of birds; and has occurred on the Irish coast. M. Audubon found its nests in vast numbers, placed upon bushes, in an island uninhabited by Man].

THE SKIMMERS (*Rhyncops*, Linn.)—

Resemble the Terns by their short feet, long wings, and forked tail; but are distinguished from all other birds by their extraordinary bill, the upper mandible of which is shorter than the other, both being flattened into simple [vertical] laminæ, which meet without clasping. Their only mode of feeding is by skimming their aliment from the surface of the water with the lower mandible as they fly.

The first known species (*Rh. nigra*, Lin.), is white, with a black calotte and mantle, a white streak over the eye, and the external tail-feathers white outside, bill and feet red. From the vicinity of the Antilles. There are four or five others.

The third family, or that of the

TOTIPALMATI,

Is characterized by the thumb being united with the other toes by one single membrane; though, notwithstanding this conformation, which renders their feet perfect oars, they are almost the only *Palmipedes* which perch on trees. All of them fly well, and have short legs. Linnæus arranged them in three genera, the first of which requires to be subdivided.

THE PELICANS (*Pelicanus*, Lin.)—

Comprehend all those wherein some naked space is found at the base of the bill. Their nostrils are mere fissures, the aperture of which is scarcely [or not at all] perceptible. The skin of the throat is more or less extensible, and the tongue extremely small. Their attenuated gizzard forms, with their other stomachs, a great sac, [which in several is furnished with an accessory pouch, analogous to that of the Crocodiles], and they have only middling or small cœca. [Their nostrils, which are always pervious in the nestling, soon become entirely closed in the greater number of genera. The furcula is always anchylosed to the anterior portion of the sternal ridge. Their eggs are encased with a soft, absorbent, chalky substance, over the hard shell; and the young are at first covered with long and flocculent blackish down, remaining very long in the nest, and generally much exceeding the parents in weight when they leave it. None of them appear to moult before the second autumn. The greater number have bright green irides.]

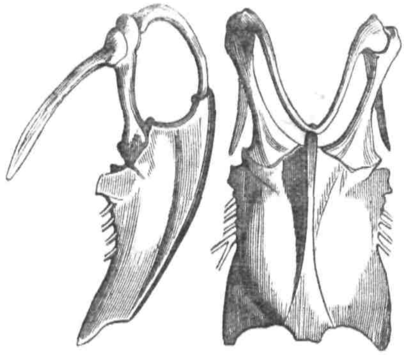

Fig. 129.—Sternum of Cormorant.

THE PELICANS, properly so called (*Pelicanus*, Illiger; *Onocrotalus*, Brisson),—

Have the beak very remarkable for its inordinate length, its straight, very broad, and horizontally-flattened form, for the hook which terminates it, and finally for the lower mandible, the flexile rim of which supports a naked membrane, which is dilatable into a voluminous pouch. Two grooves extend hroughout its length, in which the nostrils are concealed. The circumference of the eyes is naked, ike the throat. The tail round.

The common European Pelican (*Pel. onocrotalus*, Lin.).—As large as a Swan, and wholly white, slightly tinged with carneous, [and having the breast deep buff-colour in old specimens]. The hook of the bill cherry-red. It is more or less plentifully diffused over the eastern world, nidificates in the marshes, and subsists entirely on live fish. Is reported to convey provisions and water in its pouch. Two or three others have been distinguished.

THE CORMORANTS (*Phalacrocorax*, Briss.; *Carbo*, Mey.; *Halieus*, Ill.)—

Have the beak elongated, with the tip of the upper mandible hooked, and that of the other truncate. The tongue very small; and the skin of the throat less dilatable. The nostrils are like a little line, which does not seem to be pervious. The middle claw has a serrated inner edge. [Tail stiff and cuneated. It may be added, that the feet are placed backwards, in adaptation to diving habits, but are still tolerably free, these birds employing both the wings and feet in subaquatic progression. Their voracity is proverbial: and their intelligence surpasses that of most other birds, as does likewise their docility: hence they were formerly trained in Europe for fishing, as Hawks are for fowling, and they are still so employed in the East. The species are exceedingly numerous, and some are found almost everywhere.

Two are very common on the British coasts.

The Bronzed Cormorant (*Pel. carbo*, Lin.).—Size of a Gooze, and bronzed black, with fourteen tail-feathers. Both sexes develope, towards the breeding season, various accessory ornamental feathers about the head and neck, at which time the naked skin becomes brightly coloured, and a tuft of white feathers grows upon each

flank. These ornaments fall in a few weeks, and are but imperfectly developed in younger individuals, and seldom except in a state of perfect liberty. In some parts of Europe, this species builds upon house-tops, and not unfrequently on trees: but on the British coast, they mostly resort to precipitous rocks or islets, generally in society. From their croaking voice, dark colour, and appearance on the wing, they are often termed *Sea Crows.* They can climb with considerable facility, aided by the beak and rigid tail-feathers. Occasionally they fly to inland waters and fish-preserves, where they are notoriously destructive, and are observed to evince a marked preference for Eels.

The other species, or Crested Cormorant, (*Phal. cristatus*, Olass), is smaller, and less robust, with only twelve tail-feathers; its glosses incline more to green, and the adults have an elegant recurved crest during the breeding season. This bird is commoner towards the north, while the preceding is more numerous southward: nevertheless, the Bronzed Cormorant appears to occur in both continents, whereas the Crested is represented in North America by a different one (*Ph. dilophus*), both of these extending to high latitudes, though respectively peculiar to the Old and New World, so far as has yet been observed.

A third European species is the Black Cormorant (*Pel. graculus*, Gm.); a diminutive of the first, but possessing only twelve tail-feathers, like the preceding, with which it has been confounded until very recently, by British naturalists. It inhabits to the southward of the British Isles, in which it has not hitherto been met with.]

THE TACHYPETES (*Tachypetes*, Vieillot)—

Differ from the Cormorants by a forked tail, short feet, the membranes of which are very deeply notched, an excessive spread of wing, and a beak both mandibles of which are curved at the tip. Their wings are so powerful that they fly at an immense distance from all land, and principally between the tropics, darting upon the Flying-fish, and striking the Gannets to make them disgorge their prey.

One only is known (*Pel. aquilus*, Lin.), the plumage of which is [richly empurpled] black, the under-part of the throat more or less varied with white, and the beak red. Its extent of wing is reported to be sometimes ten or even twelve feet [This is the noted *Frigate-bird*, or *Man-of-War-bird*, of the English sailors, which is surpassed in command of wing by none of the class, if equalled by any. It breeds on trees on uninhabited islands, and lays a single spherical white egg.]

THE GANNETS (*Sula*, Brisson; *Dysporus*, Illiger)—

Have a straight beak, slightly compressed and pointed, with the tip a little arcuated, and its edges serrated, the denticulations [which are more developed in the Cormorants] directed backwards: the [impervious] nostrils are prolonged in a line nearly to the tip: the throat is naked, as is also the skin of the eyes; the former but slightly extensible: inner edge of the middle claw serrated. The wings are less extended than in the Tachypetes, and the tail is a little cuneated. These birds are called *Boobies*, on account of the stupidity with which they [certain species of them] allow themselves to be attacked by men and birds, more particularly the Tachypetes, which, as already stated, force them to yield up the prey they have captured.

The most common is the European Gannet (*Pel. bassanus*, Lin.).—White, with black feet and wing primaries, the bill greenish, and nearly equal in size to a Goose. [A common species in the British seas, which breeds in vast numbers upon the Bass rock in the Frith of Forth, and one or two other similar localities: the young are at first covered with the blackish down common to the group, in which they contrast remarkably with their white parents; their first plumage is dark above, beautifully speckled with white, these terminal specks gradually wearing off. The Gannets take their prey by plunging upon it from on high, and sail with an easy flight, with little motion of the wings. Their air cavities are extraordinarily developed; the ambient medium permeating all their bones with the exception of the phalanges of the toes, and passing under the skin of the breast, which is only attached to the muscles by a number of scattered connecting pillars; a structure which is also met with in the Phaetons.]

THE ANHINGAS (*Plotus*, Lin.)—

With the body and feet nearly like those of a Cormorant, have a very long neck, and a slender, straight, and pointed bill, with denticulated edges; the eyes and nudity of the face as in the Pelicans, of which they have likewise the habits, nestling, like those birds, upon trees. [They may be described as Cormorants, with the bill and neck of a Heron.

Two or three species are found, in both continents; the body inferior in size to that of a common Duck.]

THE PHAETONS (*Phaeton*, Lin.)—

Are known by their two very long and slender tail-feathers, which, at a distance, resemble a straw. Their head has no naked part. The beak is straight, pointed, denticulated, and moderately stout, [with pervious nostrils at all ages]: their feet are short, and their wings long. Accordingly, they fly very far from land, on the high seas; and as they rarely quit the boundaries of the torrid zone, their appearance serves to indicate to mariners the vicinity of the tropic, [whence their common name of

Tropic-birds]. On land, where they seldom resort except to breed, they perch upon trees. [They are closely related by affinity to the Gannets.]

Several species are known, with white plumage, more or less varied with black, [and tinged in some with roseate,] which do not exceed the size of a Pigeon.

The family of

LAMELLIROSTRES

Is distinguished by a thick bill, invested with a soft skin rather than with true horn, [the fact being, that the corneous portion is restricted to the nail-like extremity, the rest corresponding to what is known as the *cere*]: its edges supplied either with laminæ, or small teeth, [which are modifications of each other]: the tongue large and fleshy, with a dentelated border. Their wings are of moderate length. They live more in fresh waters than in the sea: and, in the greater number, the trachea of the male is dilated near its bifurcation into capsules of various form. Their gizzard is large, very muscular, and the cœca [generally] long. [These birds lay numerous spotless eggs, and the young follow their parent as soon as hatched.]

The great genus of

THE DUCKS (*Anas*, Lin.)—

Comprehends those *Palmipedes* which have a large and broad bill, the edges of which are beset with salient laminæ placed transversely, and the purport of which appears to be for straining off the water when the bird has seized its prey. They divide into three subgenera, the limits of which, however, are not very precise.

THE SWANS (*Cygnus*, Meyer)—

Have the bill of equal breadth throughout, and higher than wide at the base; the nostrils placed about midway: and the neck exceedingly elongated, [possessing twenty-three vertebræ*]. They are the largest birds of this genus, and feed chiefly on the seeds and roots of aquatic plants, [together with the grass which grows near the brink of water]. Their intestines, and cœca more especially, are accordingly very long. Their trachea has no inflation or labyrinth.

[Swans are essentially modified Geese, and like the latter are exclusively vegetable feeders, with similar plumage in both sexes, which is moulted once only in the year, and undergoes no seasonal variation of colour. They attack with the same hissing note, strike similarly with their wings, and the male guards the female during incubation, and accompanies her while followed by her brood. They fall into two subdivisions.

In the first, the trachea, after describing a slight curve towards the sternal ridge, proceeds to the lungs without entering any cavity in the bone. When swimming, they often erect the tertial plumes of the wing, in an elegant manner. Three of the four species have a fleshy caruncle over the base of the upper mandible, beneath which the bone is protuberant.

The Mute Swan (*Anas olor*, Gmelin), or common domesticated species, the adults of which are wholly pure white, with a reddish bill, surmounted by a black protuberance, and leaden-black feet: young, grey, with the bill lead-coloured. The wild breed (*C. immutabilis*, Yarrell) is rather smaller, with the rostral protuberance less developed in the few specimens examined: there is also a semi-albino domestic race, with feet whitish, or partially so, and reported to have white cygnets, which is termed the *Polish Swan* by the dealers; it varies in size, some attaining the largest dimensions of the ordinary tame breed. We are satisfied, from anatomical examination, that these are all specifically the same. The wild race is rarely met with in Britain. These birds do not appear to breed before the third year.

The Black Swan (*A. atrata*, Latham; *A. plutonia*, Shaw).—Less than the preceding, and not so elegant in its conformation, with its tertials curled upwards: colour black, with the exception of its white primaries, and the bill and naked skin at its base, which are red. It is common in New Holland, and propagates readily twice a year, or oftener, when brought to Europe.

The Black-necked Swan (*C. nigricollis*).—White, with black neck and tips of the primaries; the sides of the head white, and bill and feet orange, the former having a black protuberance. Common in South America.

The smallest of all, or Duck-billed Swan (*C. anatoides*, King.), is also from South America, inhabiting towards the Straits of Magellan. Colour pure white, with black tips to the primaries, and bill and feet orange: the former having no basal protuberance. With the exception, therefore, of the common mute species, this division pertains to the southern hemisphere.

The rest have the trachea elongated as in the Cranes, and similarly entering a cavity in the sternal

* We have found this number in four species, viz., *C. olor, atratus musicus*, and *Bewickii*.—ED.

ridge. They carry the neck more upright, and never elevate the tertial plumes. None of them has any protuberance on the base of the bill; and they have all white plumage with black feet, or, in the young, grey plumage with white wings, and the feet white when newly hatched. They yield the swan's down of commerce, which is much inferior both in quality and quantity in the others; and are restricted in their distribution to the northern hemisphere.

Fig. 130.—Sternum of Bewick's Swan.

Of four species, two are respectively peculiar to each continent.

The Trumpeter Swan (*C. buccinator*) of America is the largest, and yields most of the down of commerce, together with the next species. Its bill is wholly black, and the trachea forms a double vertical convolution within the sternal ridge, and is bifurcated into short inflated bronchi.

Audubon's Swan (*C. Audubonii* and *americana*) is smaller, but fully equals the European Hooper Swan in size, although it has been confounded with *C. Bewickii*. Its bill has an orange-yellow spot on each side towards the base, and the trachea forms a horizontal flexure within the inflated hind-margin of the sternum, having similar bronchi to those of the last.

Bewick's Swan (*C. Bewickii*) is considerably smaller, with exactly similar tracheal apparatus, and a larger orange-yellow space at the base of the bill, extending to the nostrils. Of seventeen specimens dissected by us, one only presented the horizontal flexure of the trachea (represented from the identical specimen in fig. 130), though several were evidently older birds: but the inflated form of the bronchi constitutes an invariable distinction from the next species. Tail-feathers generally twenty, sometimes eighteen, and we have more than once met with nineteen, where none had been lost. It is much less common in Britain, as a winter visitant, than the next.

The Hooper Swan (*C. musicus, Anas cygnus*, Lin.), or common Wild Swan of Europe, which visits Britain in abundance in severe winters. The largest specimens are scarcely inferior in size to the Mute species, and have the most extended brilliant-yellow space at the base of the bill of any, extending beyond the nostrils. The trachea forms but a single vertical flexure, and the bronchi are much longer than in the others, and not inflated. On dissecting a cygnet in its down, we found the cavity of the sternal ridge completely formed, but the trachea did not enter. The tail-feathers are generally twenty, and sometimes twenty-one or twenty-two. All these birds utter loud trumpeting cries, and the present species has also a low musical note, which is often repeated.]

We can scarcely distinguish from the Swans certain species, which undoubtedly are less elegant, but have the same beak. As

The Knobbed Goose (*Anas cygnoides*, Lin.), which we rear in our poultry-yards, and which interbreeds readily with the common domestic species. The base of its upper mandible is protuberant, as in the Mute Swan, and its neck is whitish, with a dark streak passing down the back of it. [In every essential particular, this is a true Goose, and has sixteen cervical vertebræ, like the rest of that genus. Its flesh is less highly esteemed than that of the common bird; than which, however, it is considerably more prolific, propagating at all seasons. As in the other Geese, it seeks its food principally, or it may be said wholly, on land, and utters loud noisy cries.]

The Spur-winged Goose (*Anas Gambensis*, Lin.).—Remarkable for its size, its elevated legs, the tubercle upon its forehead, and the two stout spurs with which the bend of its wing is armed. Its plumage is empurpled black, [very like that of a Musk Duck, to which this species is considerably allied, notwithstanding its long legs. It forms the genus *Plectropterus* of Swainson.

The author also includes among the Swans the Canada Goose (*A. canadensis*), which also possesses every intrinsic character of the true Geese. It is a very large species, with a long black neck, and white mark across the throat, as in the Black-necked Swan; which is likewise readily domesticated, and breeds plentifully in Europe. Another nearly allied (*A. Hutchinsonii*) has more recently been discovered in the same country—North America, from which neither has been known to stray across the Atlantic in the wild state, though found very far to the north. The first down of all the Geese is mottled, of the Swans plain.]

THE GEESE (*Anser*, Brisson)—

Have the bill moderate or short, narrower in front than behind, and higher than broad at the base; the legs longer than in the Ducks, and placed nearer the middle of the body, to facilitate their gait on land. They have no labyrinth at the bottom of the trachea, nor does the latter form any curve in the known species. Several [all] feed on grass and grain.

THE GEESE, properly so called,—

Have the bill as long as the head, with the ends of the lamellæ extending to its edges, and appearing like pointed teeth.

[The last-mentioned character is most strongly developed in the Snow Goose (*A. hyperboreus*) of North America, the adult male of which is white, with black primaries. This species rarely straggles into northern Europe. Four

are more or less common in Britain during the winter, tne three first of which have been much confused. The colour of all is nearly that of a coloured domestic Goose. The Grey-lag Goose (*A. cinereus*), at once distinguished by the pale grey colour of its rump, which in all the others is dark blackish-brown. The bill also is larger and broader, with more strongly marked lamellæ: the hue of it reddish flesh-colour, tinged with yellowish in summer, with always a white terminal *nail* to the upper mandible, except when very young; and the legs flesh-coloured. This, which is obviously the origin of the common tame Goose, is at present much the rarest in the British Isles, though it formerly bred abundantly in the fenny counties. The common statement that the male of the tame Goose invariably becomes white in the course of a few years, is untrue. The most nearly allied to it is the White-fronted Goose (*A. albifrons*), considerably smaller, with always a white forehead in the adult, and ordinarily more or less black on the under-parts, appearing in irregular patches; traces of which may likewise be sometimes found in the preceding species: its legs are orange-yellow, and bill flesh-coloured, with a white nail except when very young. This species is very common in winter, but has not hitherto been known to breed here. A still more abundant species is the Bean Goose (*A. segetum*), nearly as large as the first, with orange legs, and narrower bill, generally blackish, with an orange band across it, and a black nail: the latter is very rarely white in aged specimens, which often have the bill nearly wholly yellow, but never quite. The Bean Goose breeds sparingly in Sutherland, and some parts of Ireland. Lastly, the Pink-footed Goose (*A. brachyrynchus*, Baillon; *A. phœnicopus*, Bartl.) is distinguished from the last by its inferior size, and pinkish-red legs, together with its shorter bill, the similar cross-band of which is permanently of a reddish-colour. It is not very common, though more so than the first, and combines the general form of the Bean Goose with the legs of the Grey-lag.]

THE BARNACLES—

Are distinguished from ordinary Geese by a shorter and more slender bill, the edges of which conceal the extremities of the laminæ, [though there is no drawing the line of separation, and the present division is generally rejected as superfluous.

Two are common in Britain, and found on both sides of the Atlantic, each retiring very far north to breed, more particularly the second species. The Barnacle Goose (*A. leucopsis*); much smaller than any of the preceding, with a grey mantle, the feathers broadly edged with black, a black neck, and white visage: and the Brent Goose (*A. bernicla*), still less, and nearly all black above, with a white spot on each side of the middle of its neck. This bird is one of the finest for the table of the whole tribe. A third (*A. ruficollis*), common on the shores of the Caspian, and as far eastward as Lake Baikal, occurs as a rare occasional straggler, and has the smallest bill of any].

The Egyptian Goose, or Bargander, (*An. ægyptiaca*, Gm.), revered by the ancient Egyptians for the affection it evinces for its young, and remarkable for its display of colours, and for the small spur on the bend of its wing, also pertains to this subgenus: it is sometimes domesticated, but always retains a propensity to return to the wild state. [This species very properly constitutes the division *Chenelopex*, Swainson, and is a modification of the distinct Shieldrake group, all of which belong to the higher division of Geese, and not to the Ducks. There is a single inflated labyrinth at the bottom of its trachea, which, with its plumage, and the character of the down of the young, helps to intimate its real affinities*.]

THE CEREOPSIS (*Cereopsis*, Latham)—

Is a New Holland bird, nearly related to the Barnacles, [so far as the beak alone would indicate,] but with a still smaller bill, the membrane of which is much broader, and extends a little upon the forehead. [This species seldom, if ever, enters the water, and has long legs, which are bare above the joint.]

We only know one, the Grey Cereopsis (*C. cinereus*, Latham), of a grey colour, with black spots, and as large as a tame Goose. [It breeds freely in this country, and possesses a tracheal labyrinth].

THE DUCKS, properly so called, (*Anas*, Meyer),—

Have the bill broader than high at its base, and wider at the end than towards the head; the nostrils also more approximated towards its back and base. The shortness and backward position of their legs render their gait upon land more difficult than in the Geese; and they have also a shorter neck, and their trachea is inflated at its bifurcation into cartilaginous labyrinths, of which the left is generally the larger. [They subsist to a greater or less extent on animal diet, and the sexes are always different in colouring, the charge of the young being entirely left to the female, and the male approximating to the female colouring immediately after the breeding season.]

The species of the first division, or those in which the hind toe is bordered by a membrane, have a larger head, a shorter neck, the feet placed further backward, smaller wings, a more rigid tail, the tarsi more compressed, and the toes longer, with more complete webs. They walk with more difficulty, and live almost exclusively on animal food, diving very often. [The plumage is generally moulted once

* The *A. Magellanica* and *antarctica*, also, referred by the Author to his division of Barnacles, likewise appertain to the Shieldrake group as shown by their anatomy: their tracheal labyrinths are figured by M. Eyton. The truth is, that these trivial modifications of the bill are of subordinate value, in the present extensive series. —ED.

only in the year, the change of colour of the males, about midsummer, taking place without a renewal of the feathers.] Among them we may distinguish

THE SCOTERS (*Oidemia*, Fleming)—

By the breadth and inflation of the bill. [Their plumage is chiefly deep black, and they are found almost exclusively in salt water, where they prey mostly on *Testacea*. Feet particularly large.

Two species are not uncommon in the British seas—the Common or Black Scoter (*Anas nigra*, Lin.), entirely black, with an orange protuberance at the base of the bill, and orange-coloured legs; which is the most abundant, and has swollen bronchi; and the Velvet Scoter (*A. fusca*, Lin.), which is larger, with pink feet and black membranes, a white band on the wing, and spot of the same at each eye, its trachea having a sudden box-like enlargement about the middle. A third, allied to the last, the Surf Scoter (*A. perspicillata*, Lin.), occasionally strays from America, and is distinguished by the triangular patches of white on the crown and occiput: females of all dusky.

The author adds certain species to this genus, with stiff and pointed tail-feathers, forming the *Oxyura*, Bonap.; as the *A. leucocephala*, Pallas; and *A. lobata*, Shaw; which latter, a New Holland kind, is remarkable for a large fleshy appendage hanging under the bill. The *A. rubida* of Wilson is referable to the same natural division.]

THE GARROTS (*Clangula*, Leach)—

Have a shorter bill, which is narrower in front: and at their head we place a species with the middle tail-feathers very long, which renders the tail pointed. [This bird, forming the division *Harelda* of Leach, is quite distinct from the others, and moults twice in the year.]

The Long-tailed Hareld (*An. glacialis*, Lin.).—White, with a fulvous spot on the cheek and side of the neck, the breast, back, tail, and point of the wing, black: [scapularies broadly edged with rufous-brown in summer, considerably longer and pure white in winter, when they hang over the wing, as in the Eiders.] Its trachea, ossified towards the base, has on one side four square membranous facets, above which it is inflated into a bony labyrinth. [A very active and noisy marine species, not rare off the coast of Scotland in winter, flying in small flocks. Further north, it becomes exceedingly numerous.]

The Harlequin Garrot (*An. histrionica*, Lin.).—Ash-coloured, the male fantastically streaked with white; eyebrows and flanks rufous. [Also chiefly a marine species, not very closely allied to the remainder.

The rest have a very large head, or which appears, rather, to be so from the fulness of the plumage, and are remarkable for their sexual disparity of size. They are chiefly found in fresh water, and prefer to breed in the hollows ot trees, as severally observed by Linnæus, Hewitson, and Audubon. One is a common winter visitant in Britain].

The Golden-eyed Garrot (*An. clangula*, Lin.).—White, with a black head, back, and tail, a round white spot before each eye, and two white bands on the wing; female ashy, with rufous head: the middle of the trachea is very much enlarged, but preserves its flexibility, and it again becomes singularly widened towards its divarication. [The little Buffel-headed Garrot (*An. albeola*, Lin.), common in North America, is nearly allied].

THE EIDERS (*Somateria*, Leach)—

Have a longer bill than the Garrots, ascending higher upon the forehead, where it is cut into by an angle of the feathers; but which is still narrower towards the tip. [These birds are more particularly allied to the Scoters, with which they accord in their exclusively marine habits and food.

There are two species, both with long white scapularies, hanging laterally over the wing, and black and white plumage in the adult male. The Common Eider (*An. mollissima*, Lin.), with a singular green stain on each side of the neck; and the King Eider (*A. spectabilis*), remarkable for a huge protuberance over the base of its upper mandible. Both yield the celebrated Eider down of commerce].

After these separations, there still remain

THE POCHARDS (*Fuligula*, Leach),—

The beak of which is wide and flat, but offers no other marked distinguishing character. We possess several species, in all of which the trachea terminates by nearly similar labyrinths, forming a capsule to the left, in part membranous, supported by a framework and ramifications of bone.

[Three are very common in Britain,—the Scaup Pochard (*An. marila*, Lin.), grey, with leaden-coloured bill, and green-black head and neck, which is chiefly found in salt water; the Red-headed Pochard (*A. ferina*, Lin.), ash-coloured, with rufous head and neck, and black breast, nearly allied to which, but larger, is the celebrated American Canvass-back (*A. valisneria*, Wilson); and the Tufted Pochard (*A. fuligula*, Lin.; *F. cristata*, Auct.), purple-black, with pendent occipital crest, and white flanks and belly. A fourth, the White-eyed Pochard (*A. nyroca*, Gm.), is not common, and is distinguished by its maronne head and neck, the latter encircled with a black collar, and a white spot on the chin. A fifth, the Red-crested Pochard (*A. rufina*, Lin.), is larger than any of the foregoing (except the American), with elongated, bright ferrugineous, coronal feathers, and the rest mostly dark: this bird belongs properly to Asia, and is only known as a straggler so far west. Lastly, the Pied Pochard (*An. Stelleri* and *dispar*), with plumage not unlike that of an Eider, another native of eastern Asia, has likewise

been killed here. Most of these birds are very fine eating, the Scaup least so, and feed (excepting that species) principally on vegetable diet. Their cœca are larger than in nearly all of the foregoing.]

The Ducks of our second division, wherein the back toe is not bordered by a membrane, have a more slender head, the feet less broad, the neck not so long, the bill more even, the body not so thick: they walk better, and feed on aquatic plants and seeds, as well as on animal diet, [as indeed do also the preceding, though generally to a less extent]. It appears that their tracheal labyrinths consist of a homogeneous bony and cartilaginous substance, [which forms a simple vesicle. They all moult twice in the year, the males attaining, by actual change of feather about midsummer, a garb more or less similar to that of the females. They have a considerable dilatation of the œsophagus, and large cœca].

Fig. 131.—Sternum of Teal.

These likewise admit of some subdivisions, [though considerably less strongly marked than the foregoing]; and firstly, we may distinguish that of

THE SHOVELLERS (*Rhyncaspis*, Leach),—

The long beak of which is remarkable for its upper mandible forming a perfect half-cylinder, widened at the end. The lamellæ are so long and delicate that they resemble ciliæ. These birds feed on small worms, which they obtain from the mud at the edge of brooks, [and are merely true Ducks with the bill a little modified].

The Common Shoveller (*An. clypeata*, Lin.), is a very beautiful Duck, with green head and neck, white breast, rufous flanks, brown back, and wings varied with white, ash-grey, green, brown, &c., which visits us [principally] in the spring. Its flesh is excellent, and tracheal labyrinth small, [the intestines remarkably narrow and elongated]. It is the *Chenerotes* of Pliny.

An Australian species (*An. fasciata*, Shaw), is remarkable for the edge of its beak being prolonged on each side into a hanging membranous flap. [The Shovellers grade into the ordinary Ducks by a succession of species, allied to the British Gargany Duck, which latter retains much of the same character of plumage and colouring.]

THE SHIELDRAKES (*Tadorna*, Leach)—

Have the bill very much flattened towards the end, with a projecting boss at the base. [These birds are the most duck-like representatives of an extensive group, found chiefly in the southern hemisphere, and intermediate in their general characters to the present group of Ducks with unlobated hind-toe, and the Geese, but exhibiting none of the essential characters of the former. Like the Ducks, they have always a brilliant speculum of metallic colouring on the wing, and an inflated vesicle, in some single, towards the divarication of the bronchi: but they are exclusively vegetable feeders; the male guards the nest, and protects his brood, uttering with outstretched neck a hissing sound at any intruder; their plumage is moulted but once a year, and undergoes no seasonal change of colour, being generally alike in both sexes, or, when different, the male is white, as in certain Geese; and lastly, they have a gait very different from that of the Ducks, all of them standing high upon the legs, and their young are at first pied, unlike those of other *Lamellirostres*. In all that we have examined, the intestines are particularly long and slender. Their subdivision is not easy; and the common Shieldrake and Egyptian Goose, or Bargander, may be cited as characteristic examples: the wings of most are very similar.

The Common Shieldrake (*An. tadorna*, Lin.; *T. vulpanser*, Auct.).—White, with a green head and neck, a cinnamon-brown cincture round the breast, and black streak down the belly; the wing variegated with black, white, rufous, and green. Common on the shores of the North Sea and of the Baltic, where it nestles in the downs, generally in deserted Rabbit burrows, [and not rare on the British coasts, subsisting on fuci]. The trachea swells into two nearly similar osseous capsules at its divarication.

[Another, of eastern Europe and Asia, the Ruddy Shieldrake (*T. rutila*), has been known to stray westward as far as Britain. It has more the characters of a Goose, and chiefly inhabits the banks of large rivers. Wing like the common species, the rest of its plumage chestnut-rufous, whitish on the head and neck.]

Some Ducks of this second division have naked parts on the head, and often likewise a boss at the base of the beak; as,

The Musk Duck (*A. moschata*, Lin.).—Originally from America, where it is still found wild, and is observed to perch upon trees; it is now very common in our poultry-yards, where it is reared on account of its size. It readily hybridizes with the common species, [producing infertile hybrids]. Its capsule is very large, circular, vertically flattened, and on the right side only. [Its legs are very short, both sexes are alike in plumage, the male guards the nest and brood, and we consider it to be an extreme modification of the group of Shieldrakes.]

Some have the tail pointed.

The Pintail Duck (*A. acuta*).—[A common winter visitant in Britain, highly esteemed for the table; the male with a white mark down each side of the neck, meeting behind. It forms, with another, the needless division *Dafila* of Leach.]

In others, the middle tail-feathers are more or less curled upwards; as,

The Common or Mallard Duck (*A. boschas*, Lin.); known by its orange feet, greenish-yellow bill, the fine changeable green of its neck, separated from the dark maronne colour of its breast by a white ring, &c. In our poultry-yards, it varies like other domestic animals. The wild bird, common in our marshes, nestles among the rushes, in old trunks of willows, and sometimes upon trees. Its trachea terminates below with a great osseous capsule.

Some of them have a crested head, and a bill rather narrower anteriorly, and which, though foreign, are now raised in all our aviaries. [They have smaller feet, perch readily on trees, and surpass all the rest of the tribe in the splendour of their colours. They constitute the *Dendronessa*, Swainson].

Such is the Mandarin Duck (*A. galericulata*) of China, and the Summer Duck (*A. sponsa*) of North America. Their capsules are rounded, and of moderate size.

Other exotic species conjoin to the bill of the Ducks, legs which are even longer than those of the Geese: they perch and nestle upon trees.

[These are the long-legged Whistling Ducks of the West Indies, which pertain to the major division of Shieldrakes, and form the subgenus *Dendrocygnus*.] One of the number has even semipalmated toes.

Lastly, among those which have no particular characteristic, the following visit our shores during the winter.

The Gadwall Duck (*A. strepera*, Lin.), mostly of a lineated grey colour, with some rufous on the wings; the Widgeon (*A. penelope*, Lin.); grey, with a vinaceous breast, and rufous head and neck, the forehead and along the top of the head yellowish-white; the Teal (*A. crecca*), with a rufous head, marked with green on each side, and a spotted breast; and the Gargany (*A. querquerdula* and *circia*), with a white stripe behind the eye. [In addition to these, two stragglers have been found in Britain, the Bimaculated Duck, (*A. glocitans*,) from Asia, allied to the Teal, but larger, with a brown head, having two large glossy green spots on each side; and the American Widgeon, with a Teal-like green stripe on the sides of the head (a trace of which is sometimes met with in the common Widgeon), no rufous on the head, a narrower bill, and smaller tracheal capsule. In all these the females have lineated brown plumage, which is characteristic of the true double-moulting *Ducks* with unlobated hind-toe, and the males are finely rayed across. The habits of all are nearly similar to those of the common species.]

The genus of

THE MERGANSERS (*Mergus*, Lin.)—

Comprises species, the bill of which, much more slender and cylindrical than in any of the foregoing, has each mandible armed throughout its length with small pointed teeth like those of a saw, directed backwards, [and which are merely modifications of the ordinary lamellæ]; the tip of the upper mandible is hooked. Their port and even their plumage are the same as in the Ducks, properly so called; but their gizzard is less muscular, and the intestines and cœca are shorter, [though less so than in the Scoters and Eiders. They have a lobated hind-toe, and the plumage is moulted in autumn only, the colours of the male undergoing an extraordinary amount of change towards midsummer. They do not acquire their adult dress until the second general renewal of the feathers]. The labyrinth at the inferior larynx of the males is enormous, and in part membranous [resembling that of the other Ducks with lobated hind-toe]; and they live on lakes and ponds, where they are very destructive to fish, breeding in similar situations to the common Duck.

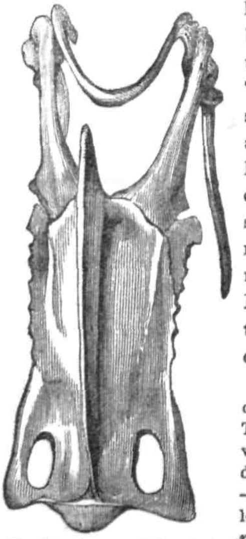

Fig. 132.—Sternum of Merganser.

[Of five species, four are met with in the British Isles, three of them commonly during the winter. All are beautiful birds, at least the males in breeding dress. They are—the Great Merganser (*M. merganser* and *castor*), as large as a Shieldrake, with green head and neck, and short bushy crest, the body white, more or less deeply suffused with saffron, with a blackish mantle, coral bill, and orange legs,—the male; and female rufous-brown, white beneath, with a slender and much longer crest; which retires further north to breed: the Bay-breasted M. (*M. serrator*), size of a Mallard, with a rufous brown breast, spotted with blackish, a green-black head and neck, surmounted with a long thin crest, white ring round the neck, and elegant bordered shoulder-tufts; female very like the last; which breeds on our northern lakes: and

the Hooded M. (*M. cucullatus*), an American species, rare on this side of the Atlantic, the size of a Widgeon, with a very large fan-like crest, white bordered with black. These have two cœca of moderate length, and the trachea of the first presents two successive inflations in its course, which are about equal, the same expansions being also visible in the second species, wherein the higher is however increased, and the lower one diminished, in addition to the labyrinth at the inferior larynx. To this first group would seem also to belong the *M. braziliensis*, which is peculiar to South America.

Finally, the Smew Merganser (*M. albellus*) is very remarkable for possessing only one minute cœcum, resembling that of a Heron. It is an extremely beautiful bird, proper to the eastern Continent, and not rare in Britain during the winter, the male of which is bright glistening white, variegated with black markings, and the female like that of the others, except that the adult has a black patch before each eye. It retires far north to breed.

The great division of web-footed birds might be naturally arranged into five principal groups, continuatory with those indicated at the close of the series of Waders: viz.—

XI. NATATORES (*Swimmers*); including the Flamingo, but corresponding otherwise to the *Lamellirostres* of Cuvier.

XII. MERGITORES (*Immergers*); restricted to the two distinct families of Loons and Grebes.

XIII. PISCATORES (*Fishers*); or the *Totipalmati*, which are all exclusively piscivorous.

XIV. VAGATORES (*Wanderers*); or the *Longipennes;* containing the two perfectly distinct groups of the Terns, Gulls, and Skuas, and of the Albatrosses and Petrels.

XV. URINATORES (*Divers*); more properly so designated; and composed of the separate families of Auks and Penguins.

THE THIRD CLASS OF VERTEBRATED ANIMALS.

REPTILIA.

These have the heart so constructed that at each contraction a portion only of the blood received from the various parts of the system is sent into the lungs, the remainder of this fluid returning into the general circulation without having passed through the lungs, and consequently without having been subjected there to respiration.

Hence, it results that the action of oxygen upon the blood is less than in the Mammalia, and that, if the amount of respiration of the latter, wherein the whole of the blood is obliged to pass through the lungs before returning into the system, be expressed as unity, the quantum of respiration of Reptiles should be expressed as a fraction of unity proportionately small, as the quantity of blood propelled into the lungs, at each contraction of the heart, is diminished.

As respiration imparts the warmth to the blood, and the susceptibility of the fibre to nervous irritamen, Reptiles have cold blood, and their aggregate muscular energy is less than in the Mammalia, and much less than in Birds. Hence, their movements can scarcely be performed otherwise than by crawling or swimming: and though several of them leap and run with celerity on certain occasions, their habits are generally sluggish, their digestion excessively slow, their sensations obtuse, and, in cold or temperate climates, they pass nearly the whole winter in a state of lethargy. Their proportionally very diminutive brain is less necessary than in the two preceding classes for the exercise of their animal and vital functions; their sensations seem to be less referrible to a common centre; they continue to live and to execute voluntary movements, for a very considerable while after having been deprived of the brain, and even when the head is severed. The connexion with the [main trunks of the] nervous system is also much less necessary for the contraction of the muscular fibre;

and their flesh preserves its irritability much longer, after having been separated from the rest of the body, than is the case with the preceding classes. Their heart pulsates for many hours after it has been detached, and its loss does not deprive the body of mobility for a still longer period. It has been remarked of some which have the cerebellum extremely diminutive, that this circumstance has some reference to their disinclination to move.

The smallness of the pulmonary vessels enables Reptiles to suspend their respiration without arresting the course of the blood, and thus to remain submerged with less difficulty, and for a longer time, than Mammalia or Birds. The cells of their lungs are not so numerous, as they contain fewer vessels within their precincts, and they are also much larger, these organs having sometimes the form of simple sacs, merely a little cellular.

For the rest, Reptiles are provided with a trachea and larynx, although they have not all the power of emitting an audible voice.

Their blood not being warm, they consequently do not require teguments capable of retaining heat; and they are accordingly covered with scales, or simply with a naked skin.

The females have a double ovary and two oviducts, and the males of several genera have a forked or double penis, but in the last order (that of the Batrachians), they have [mostly] none at all.

No Reptile incubates its eggs. In several genera of Batrachians, these are not fecundated until after they have been excluded; they have merely a membranous envelope. The young of this last order have, on quitting the egg, the form and gills of Fishes; and certain genera retain these organs even after the developement of their lungs. In other Reptiles which produce eggs, the Snake, for example, the young is already formed and considerably advanced within the egg at the time the parent deposits it; and there are even some species which may be rendered viviparous at will, by retarding the deposition of their eggs, as M. Geoffroy exemplified by depriving the common Snake of water.

The amount of respiration in this class is not fixed, as in the Mammalia and Birds; but it varies according to the relative proportion of the diameter of the pulmonary artery, as compared with that of the aorta. Thus, Tortoises and Lizards respire much more than Frogs, &c. [though the latter, it should be observed, respire in part over the whole damp skin, as conclusively ascertained by the experiments of Dr. Milne Edwards]. Hence, the differences of energy and sensibility are very much greater than those between one Mammalian and another, or one Bird and another.

Reptiles also present more varied forms, characters, and modes of gait, than the two preceding classes; and it is in their production more especially, that Nature seems to have tried to imagine grotesque forms, and to have modified in every possible way the general plan adopted for all vertebrated animals, and for the oviparous classes in particular.

A comparison of the extent of their respiration with their organs of movement has led M. Brongniart to divide them into four orders, which are as follow :—

The CHELONIANS (or Turtles and Tortoises), which have a heart with two auricles, and the body of which, supported by four limbs, is enveloped by two plates or bucklers formed of the ribs and sternum.

The SAURIANS (or Lizards), which have a heart with two auricles, and the body of which, borne on four or two feet, is covered with scales.

The OPHIDIANS (or Serpents), having a heart with two auricles, and the body of which is always deprived of feet. And

The BATRACHIANS, the heart of which has only one auricle; [Prof. Owen has shown that these also possess two]; and which have a naked body, that in the greater number passes, with age, from the form of a Fish respiring by gills, to that of a Quadruped breathing by lungs. Some of them, however, never cast their gills; and there are certain species which have only two feet.

Other authors, as Merrem, have made a different partition of the Saurians and Ophidians. They detach the Crocodiles to form an order [*Loricata*] by themselves, and place the rest of the Saurians with the first family of Ophidians (or that of the Orvets), which mode of distribution is founded on certain peculiarities of the organization of the Crocodiles, and upon a certain affinity of the Orvets for the Lizards. We have deemed it sufficient to indicate these affinities, which are nearly all internal, adopting, nevertheless, a division of more easy application. [In consequence, however, of rejecting this obvious natural arrangement, the Ophidians and Saurians of our author grade into each other; whereas the more intrinsical characters remain inviolate, and indicate three natural groups of *Loricata*, *Saurophidia*, and *Ophidia*.]

THE FIRST ORDER OF REPTILES,—

CHELONIA,—

Better known by the appellation of Tortoises [*Testudinata*], have a heart with two auricles, and a ventricle with two unequal chambers, which communicate together. The blood from the body enters the right auricle, and that from the lung the left; but the two streams mingle more or less in passing through the ventricle.

These animals are distinguished, at the first glance, by the double buckler in which their body is inclosed, and which only allows the head and neck, the tail, and the four limbs, to be protruded.

The upper buckler, termed the *carapace* or shield, is formed by the ribs, in number eight pairs, which are widened and joined together, and also to the plates adhering to the annular portion of the dorsal vertebræ, by dentelated sutures, so that the whole is completely deprived of mobility. The inferior buckler, named the *plastron* or breast-plate, is formed of pieces which represent the sternum, and which are ordinarily nine in number. A frame-work composed of bony pieces, which are believed to have some analogy to the sternal or cartilaginous portion of ribs, and which in one subgenus even remains cartilaginous, surrounds the carapace, and unites all the ribs which compose it. The cervical and caudal vertebræ are alone moveable.

These two bony envelopes are immediately covered by the skin, or by scales; the scapula, and all the muscles of the arm and neck, instead of being attached to the ribs and spine, as in other animals, are all underneath, as are also even the bones of the pelvis and all the muscles of the thigh; so that, in this respect, a Tortoise may be regarded as an animal turned inside-out.

The vertebral extremity of the blade-bone is articulated to the carapace; and its opposite extremity, which may be considered as analogous to a clavicle, is articulated to the breast-plate; so that the two shoulders form a ring, through which pass the œsophagus and trachea.

A third bony ramification, larger than the two others, and directed backwards and downwards, represents, as in Birds, the coracoid apophysis; but its extremity remains free.

The lungs are much extended, and situate in the same cavity with the other viscera. The thorax being in the greater number immoveable, it is by the action of the mouth that the Tortoise breathes, by holding its jaws firmly closed, and alternately depressing and raising the hyoid bone: the first of these movements permits the air to enter by the nostrils; when, the tongue immediately closing their internal aperture, this second operation forces the air into the lungs. The same mechanism occurs in the Batrachians.

Tortoises have no teeth; but their jaws are invested with horn like those of Birds, except in the Chelydes, in which they are merely covered with skin. Their ear-drum and palatal arches are fixed to the skull, and immoveable; their tongue is short, and beset with fleshy papillæ; their stomach simple and strong; their intestines of mean length, and without a cœcum; and they have a very large bladder. The male has a simple penis of considerable size; and the female produces eggs covered with a hard shell. The male may often be recognized externally, by the concave form of the breast-plate.

These animals are very retentive of life, and will continue to move for many weeks after having been deprived of the head. They require very little nourishment, and can pass whole months and even years without eating. Linnæus united them all in the genus of

THE TORTOISES (*Testudo*, Lin.),—

Which have been divided into five subgenera, principally after the form and teguments of their carapaces and feet.

THE LAND-TORTOISES (*Testudo*, Brongniart)—

Have a bulged carapace, sustained by a bony skeleton wholly solid, and anchylosed for the greater part to the lateral edges of the breast-plate; their legs are truncated, with very short toes connected almost to the nails, and are capable, together with the head, of being completely withdrawn into the armour; the fore-feet have five nails, and the hinder four, all thick and conical. Several species subsist on vegetable matter.

The Greek Tortoise (*T. græca*, Lin.), is that which is commonest in Europe. It inhabits Greece, Italy, Sardinia, and (it would appear) all round the Mediterranean; is rarely a foot long; feeds on leaves, fruit, insects and worms; and burrows a hole in which it passes the winter: it engenders in spring, and lays four or five eggs resembling those of Pigeons.

Among the foreign species, there are several in the East Indies of enormous size, measuring three feet and upwards in length. One is more particularly known as the Indian Tortoise (*T. indica*, Vosm.), of a deep brown colour, with the carapace compressed in front, and its anterior border reverted above the head. Others are remarkable for the pleasing distribution of their colours, as the Geometrical T. (*T. geometrica*, Lin.), a small species with a black carapace, each scale of which is regularly adorned with yellow lines radiating from a disk of the same colour. A nearly similar but much larger kind (*T. radiata*) inhabits New Holland.

Some species (the *Pyxis*, Bell), have the anterior portion of the mouth moveable, as in the Terrapins; and others (the *Kinixys* of the same naturalist) can move the hinder part of their carapace, but we have some reason to suspect that this latter conformation is merely accidental.

THE EMYDES, or Freshwater Tortoises (*Emys*, Brongniart)—

Have no other constant characters to distinguish them from the preceding, beyond the further separation of their toes, which are also terminated by longer nails, and the intervals between them are occupied by membranes, though they grade even in this particular. They also possess five nails before and four behind. The structure of their feet adapts them to more aquatic habits. The greater number live on insects, small fish, &c.; and their envelope is generally flatter than in the Land-tortoises.

That of Europe (*T. europea*, Schn.; *T. orbicularis*, Lin.), is the most widely diffused, and inhabits all the south and east of Europe as far as Prussia. It attains a length of ten inches, and its flesh is eaten, with a view to which it is fed upon bread and tender herbage; but it also subsists on insects, slugs, small fish, &c. Marsigni states that its eggs require a year to hatch. The Painted Emyde (*T. picta*, Schæff.) is one of the prettiest species, brown, with each scale encircled with a yellow riband, more wide in front. It is found in North America among the reeds, upon the rocks, or on the trunks of trees, from which it falls into the water on being approached. There are very many others.

M. Fitzinger separates, under the name of *Chelodina*, and Mr. Bell under that of *Hydraspis*, those species which have an elongated neck, as *Em. longicollis*, Shaw, &c.

Among the Fresh-water Tortoises may be noticed more particularly,

THE TERRAPINS, or Box-Tortoises, (*Terrapene*, Merrem; *Kinosternon*, Spix; *Cistuda*, Fleming),—The breast-plate of which is divided into two pieces by a moveable articulation, and which have the power of completely closing their carapace when the head and limbs are withdrawn into it.

Some have only the anterior segment of the breast-plate moveable, as *T. subnigra*, Lin., and *T. clausa*, Schæff.; while in others both segments are equally mobile, as *T. tricarinata*, Schæff., and *T. pennsylvanica*, Id.

There are some Fresh-water Tortoises,

THE CHELYDRONS (*Chelydra*, Fitzinger; *Chelonura*, Fleming),—

Which have a long tail and great limbs, that cannot be quite withdrawn within their armour. They approximate to some of the following genera, and more particularly to the Chelydes, and should rank as a particular subdivision.

Such is the Long-tailed Tortoise (*T. serpentina*, Lin.), which is known by having its tail almost as long as the carapace, and beset with dentelated and pointed crests, and pyramidal scales. It inhabits the warm regions of North America, is very destructive to fish and water-fowl, ascends far up the rivers, and sometimes attains a weight of twenty pounds.

THE TURTLES (*Chelonia*, Brongniart; *Caretta*, Merrem)—

Have their envelope too small to receive the head, and more especially the feet, which latter are extremely elongated, (particularly those in front,) flattened to serve as oars, and have all their toes closely united, and enveloped in the same membrane. The two first toes alone of each foot are furnished with pointed nails, and even these are apt to fall, one or the other of them, at a certain age. The pieces which compose their plastron do not form a continuous plate, but are variously dentelated, and leave great intervals, which are occupied only by cartilage. Their ribs are narrowed, and separate one from another at their external portion, but the entire circumference of the carapace is occupied by a circle of pieces corresponding to sternal ribs. The temporal fossa is covered over by an arch formed of the parietals and other bones, in such a manner that the whole head is guarded by a continuous bony casque. The œsophagus is internally armed throughout with cartilaginous points, and sharp tubercles directed towards the stomach.

The Edible or Green Turtle (*T. midas*, Lin.) is distinguished by its greenish scales, to the number of thirty, which do not cover each other in the manner of tiles, and the medial of which are ranged in almost regular hexagons. It attains a length of six or seven feet, and a weight of seven or eight hundred pounds. Its flesh supplies an agreeable viand, very wholesome to mariners traversing the torrid zone. It feeds in great troops upon the algæ in the depths of the ocean, and approaches the mouths of rivers to respire. Its eggs, which are deposited in the sand where the sun may warm them, are very numerous, and fine eating; but its shell is not employed in manufactures.

A neighbouring species (*Ch. maculosa*, Nobis,) has the middle plates twice as long as wide, and of a fulvous colour, marked with great black spots; and another (*Ch. lachrymata*, Nobis,) has plates as in the preceding one, but raised into a boss posteriorly, and black splashes upon the fulvous. The scales of both these are useful in manufactures.

The Imbricated Turtle (*T. imbricata*), which is less than the green one, with a more lengthened muzzle and dentelated jaws, and bearing thirteen yellowish and brown scales, which cover each other in the manner of tiles, furnishes the best *tortoise-shell* employed in the arts; but its flesh is disagreeable and unwholesome, though the eggs are very delicate. It inhabits the seas of hot climates.

There are yet two species allied to the Imbricated Turtle, the *Ch. virgata*, Nobis, the scales of which are more raised, and the medial equal, but with more pointed lateral angles, and radiating black lines; and *Ch. radiata*, Schæff., which merely differs from the last by having the hindmost of its middle scales wider, being perhaps a mere variety.

Finally, the Hawk-billed Turtle (*T. caretta*, Gm.) is more or less brown or rufous, with fifteen scales, the medial of which have raised crests, more particularly towards the extremity; the point of the upper mandible is crooked, and the fore-feet longer and narrower than in the others, preserving also better-marked nails. It inhabits several seas, and even the Mediterranean, subsists on Testacea, has bad flesh, and shell which is in low estimation, but it furnishes an oil that burns well.

Merrem has recently distinguished, as

THE LEATHERBACKS (*Sphargis*, Ill.; *Coriudo*, Fleming; *Dermochelis*, Lesueur),—

Those species which have no scales, but the carapace of which is invested with a sort of leather.

Such is a large species of the Mediterranean [which has occurred two or three times on the British shores] (*T. coriacia*, Lin.), the carapace of which is oval, and pointed behind, with three prominent longitudinal ridges. There is another in the Atlantic (*Dermochelis atlantica*, Lefevre].

THE CHELYDES (*Chelys*, Dumeril; *Matamata*, Merrem)—

Resemble the Emydes by their feet and nails; but their envelope is much too small to inclose the

head and feet, which are particularly large; their nose is prolonged into a little trunk; but the most strongly marked of their characters consists in having their widely-cleft mouth not armed with a horny beak, as in other *Testudinata*, but rather resembling that of certain Batrachians, which form the genus *Pipa*.

The Matamata (*T. fimbria*, Gm.).—The carapace bristled with pyramidal eminences, and the body fringed all round with laminæ, as if cut. An inhabitant of Guiana.

THE SOFT TORTOISES (*Trionyx*, Geoff.)—

Have no scales, but merely a soft skin enveloping both the carapace and plastron, neither of which is completely supported by bone, the ribs not reaching to the borders of the carapace, nor being united together for more than a portion of their length, the parts analogous to sternal ribs being replaced by a simple cartilage, and the sternal pieces being partly dentelated, as in the Turtles, and not covering the whole inferior surface. After death it is perceptible, through the dry skin, that the surface of the ribs is very jagged. The feet, as in the Emydes, are palmated without being lengthened, but only three of their toes are provided with nails. The horn of their beak is invested with fleshy lips outside, and their nose is prolonged into a small trunk. The tail is short, and the orifice of the anus beneath its extremity. They inhabit fresh water, and the flexible borders of their envelope assist them in swimming.

The Trionyx of the Nile (*T. triunguis*, Forsk and Gm.; *T. ægyptiacus*, Geoff.) is sometimes three feet long, and of a green colour spotted with white; the carapace but slightly convex. It devours the young Crocodiles as soon as they are excluded, and thus renders more service to the Egyptians than even the Mangouste.

The American Trionyx (*T. ferox*, Gm.) inhabits the rivers of Carolina, Georgia, Florida, and Guiana; and lies in ambuscade at the roots of the weeds, seizing on birds, reptiles, &c., and devouring the young Alligators, while itself becomes the prey of the larger ones. Its flesh is good eating. There are several more.

THE SECOND ORDER OF REPTILES,—

SAURIA,—

Have the heart composed, as in the *Chelonia*, of two auricles, and a ventricle sometimes divided by imperfect partitions.

Their ribs are moveable, attached partly to the sternum, and can rise and fall for the purpose of respiration.

Their lung extends more or less towards the hinder part of the body, often penetrates considerably forward below, and the transverse muscles of the abdomen slide under the ribs so far as to entwine the neck. Those in which the lungs are most developed exercise the singular faculty of changing the colours of their skin, according as they are influenced by their wants or by their passions.

Their eggs have an envelope more or less indurated; and the young issue from them with the form which they retain ever afterwards.

The mouth is always armed with teeth; their toes, with very few exceptions, are furnished with nails; the skin is covered with scales more or less serrated, or at least with little scaly granules; and they engender with either a single or double male organ, according to the genus.

All have a tail more or less lengthened, and in nearly every instance very thick at the base: the greater number have four limbs, though some have only two.

Linnæus arranged them into only two genera, the Dragons and the Lizards; but the latter requires to be divided into several, which differ in the number of feet, of intromittent organs, in the form of the tongue, of the tail, and of the scales, so that we are obliged to separate them even into families.

The first of these, or that of the CROCODILES, comprises but one genus,—

THE CROCODILES (*Crocodilus*, Brongniart),—

Animals of large size, which have the tail flattened at its sides, five toes on the fore-limbs, and four on

the hind, of which the three inward only of each foot are furnished with claws, all of them being more or less connected by membrane; a single row of pointed teeth in each jaw; the tongue flat and fleshy, and attached very near to its edges, which led the ancients to believe that it was altogether wanting; the penis single; the anal orifice longitudinal; the back and tail covered with great square scales of exceeding strength, having an elevated ridge along their middle; and a deeply dentelated crest upon the tail, double at its base. The scales of the belly are also square, but smooth and narrow. The nostrils, opening at the tip of the muzzle by two small transverse fissures which close as valves, are continued by a long straight canal pierced in the palate bones and sphenoid, as far as the throat.

The lower jaw is prolonged backward beyond the skull, which occasions the upper one to appear moveable, as the ancients asserted to be the case: the latter can only move, however, with the entire head.

The external ear is closed at will by two fleshy lips; and the eye has three lids. Under the throat are two small holes, the orifices of glands, where a musky pommade is secreted.

The vertebræ of the neck are propped together by little false ribs, which render lateral movement difficult: hence these animals cannot readily change their course, and are easily avoided by turning. They are the only Saurians which have no clavicular bones; but their coracoid apophyses are attached to the sternum, as in all the others. Besides the ordinary true and false ribs, their abdomen is protected by others, which do not ascend to the spine, and which appear to be produced by the ossification of the tendinous extremities of the straight muscles.

Their lungs do not penetrate into the abdomen, as in other Reptiles; and the fleshy fibres adhering to the portion of peritonæum which invests the liver, impart the appearance of a diaphragm; circumstances which, conjoined to the particular of their heart being divided into three chambers, wherein the blood that comes from the lungs does not mingle so completely with that of the body as in other Reptiles, ally these animals somewhat nearer to the warm-blooded quadrupeds.

Their ear-drum and pterogoid apophyses are fixed to the skull, as in the Tortoises.

Their eggs are hard, and the size of those of domestic Geese, whence the Crocodiles are reputed to be, of all animals, those which attain the greatest dimensions considering their size at birth. The females guard their eggs, and continue to protect the young for some months after exclusion.

They inhabit fresh water, and are very carnivorous, but are unable to swallow under water; and their habit is to drown their prey, and then place it in some hole beneath the surface, where they leave it to putrefy before they devour it.

They differ, indeed, so much from other Lizards, that several recent authors have deemed it necessary to make of them a particular order, termed *Loricata* by Merrem and Fitzinger, and *Emydosaura* by De Blainville.

The species, more numerous than has hitherto been supposed, fall into three distinct subgenera.

THE GAVIALS, Cuv.,—

Have the muzzle slender, and very much elongated; the teeth about equal; the hind-feet dentelated at their external edge, and webbed to the ends of the toes; two great perforations in the bones of the skull behind the eyes, which may be discerned outside the skin. They have only been observed on the eastern continent.

That of the Ganges (*Lac. gangetica*, Gm.), which attains a large size, is remarkable, not only for the length of its muzzle, but for a large cartilaginous prominence surrounding the nostrils, which throws these backwards, and led Ælian to assert that the Gangetic Crocodile had a horn at the tip of its snout.

THE CROCODILES, properly so called,—

Have the muzzle oblong and flattened, the teeth unequal, but resemble the Gavials in other respects. Some of this form occur on both continents.

THE CAYMANS, or Alligators (*Alligator*, Cuv.)—

Have a broad and obtuse muzzle, and uneven teeth, the fourth below entering into cavities of the upper jaw, and not the interstices of the upper teeth, as in the preceding; their feet are only semi-palmated, and undentelated; and the species are only known to inhabit America.

THE SECOND FAMILY OF THE SAURIANS,—

THE LIZARDS,—

Is distinguished by its slender, extensible, and forked tongue, as in the Snakes; by its lengthened body and rapid gait; the feet have each five toes furnished with claws, which are separate and unequal, more particularly those behind; their scales, under the belly and around the tail, are disposed in parallel transverse bands; their tympanum, which is on the upper part of the head, is membranous and shallow; a production of the skin, split longitudinally, and which closes by a sphincter, protects the eye, beneath the front angle of which is a vestige of a third eyelid; their false ribs do not form a complete circle; the males have a double penis; and the anus is a transverse aperture.

The species are very numerous and much varied, and we subdivide them into two great genera.

THE MONITORS (recently termed, by a singular mistake, *Tupinambis*),—

Are the largest of the whole tribe; they have teeth in both jaws, but none on the palate, and the greater number have the tail laterally compressed, in adaptation to aquatic habits. Frequenting the vicinity of the haunts of Crocodiles and Alligators, it is said that they give warning, by a whistling sound, of the approach of those dangerous reptiles, and hence, probably, their names of *Sauvegarde* and *Monitor*, though this is not quite certain.

They divide into two distinct groups. The first, or that of

THE MONITORS, properly so called,—

Are known by their numerous small scales upon the head and limbs, the belly, and around the tail, which latter has a keel above, composed of a double range of projecting scales. Their thighs do not exhibit that range of pores found in most other Saurians. All are from the ancient continent.

Two species, in Egypt, have been considered the types of separate subdivisions; the Nilotic M. (*Lac. nilotica*, Lin.), of *Varanus*, and the Ground M. (*L. scincus*, Merrem), of *Psammosaurus*, both of Fitzinger. Africa and India produce many more, with sharper teeth and still more compressed tail.

The other group of Monitors has angular plates upon the head, and great rectangular scales upon the belly and around the tail. The skin of their throat is invested with small scales, and forms two transverse folds. They have a range of pores on the inside of each thigh. Two subdivisions are required.

The first, or that of

THE DRAGONETS (*Crocodilurus*, Spix; *Ada*, Gray),—

Is distinguished by caudal crests, like those of the Crocodiles, formed of raised scales; their tail is compressed. Such is

The Great D. of Guiana (*M. crocodilinus*), Merr.), which attains a length of six feet, and is eaten. There are various others in the hot regions of America.

THE RESTRICTED MONITORS (*Monitor*, Fitzinger),—

Have no keeled scales either on the back or tail; their teeth are denticulated, but with age the hindmost become rounded.

Some, more particularly termed *Sauvegardes*, have the tail more or less compressed, and the belly scales longer than broad; they frequent the borders of water. One, in Brazil and Guiana, attains to six feet in length. It runs swiftly on the ground, and takes to the water when pursued, into which it plunges, but does not swim; it devours all sorts of insects, reptiles, the eggs of poultry, &c., and nestles in holes which it burrows in the sand. Its flesh and eggs are eaten.

Others, termed *Amœva*, merely differ in having a round tail, covered, as is also the belly, with transverse ranges of keeled scales, which on the belly are broader than long. They are American animals, which resemble our Lizards extremely, but, besides wanting molar teeth, the greater number have no collar, and all have minute scales on the throat; their head, also, is more pyramidal than in the Lizards, and they have no bony plate over the orbit.

THE LIZARDS, properly so called,—

Form the second great genus of this tribe. They have the back portion of the palate armed with two ranges of teeth, and are otherwise distinguished from the preceding animals by a collar round the neck, which is formed by a transverse range of broad scales, separated from those of the belly by a space covered with small ones like those of the throat, and also by a part of the bones of the skull advancing over the temples and orbits, so that the whole head is defended by a bony casque.

The species are very numerous, and many are found in Europe [though two only in this country, *L. agilis*, which is comparatively rare, and *L. vivipara*, which, unlike the other, is ovoviviperous, as in the Vipers, and extremely

common upon heaths and sunny banks. One of a beautiful green colour, (*L. viridis*), is common over the south of Europe, and in the Channel Islands.]

The division *Algyra*, Cuv., has the dorsal and caudal scales carinated; those of the belly imbricated and smooth, and no collar round the neck.

Tachydromus, has square carinated scales upon the back, under the belly, and on the tail; neither collar nor femoral pores; but on each side of the anus is a small vesicle, opening by a pore. Their body and tail are very much elongated, and the tongue still longer than in the Lizards.

THE THIRD FAMILY OF THE SAURIANS,—

THE IGUANA GROUP,—

Have the general form, long tail, and few and unequal toes of the last series; the eye, ear, double penis, and anus, also similar; but their tongue is thick, fleshy, and non-extensible, and is notched only at the tip. They fall into two sections; the first having no palatal teeth, in which the following genera are arranged.

THE STELLIONS (*Stellio*, Cuv.)—

Which, with the general characters of this family, have the tail encircled with rings of large scales, that are often spinous. The subgenera are as follow.

Cordylus, Gronov., which have not only the tail, but the belly and back covered with large scales, transversely arranged. Their head, as in the common Lizards, is protected by a bony casque, and covered with plates. In several species, the points of the caudal scales form spinous circles; there are, also, little spines on those of the sides, the back, shoulders, and outside of the thighs. The latter have a line of large pores.

Stellio, Daud.—Caudal spines middle-sized; the head posteriorly swollen by the muscles of the jaws; the back and thighs bristled with scales larger than the others, and sometimes spinous; little groups of spines encircling the ear; no femoral pores, and the tongue lengthened to a point. But one species is known, which inhabits the Levantine countries, where it is persecuted by the Mahometans, who conceive that it mocks their actions when praying.

Doryphorus, Cuv.—No femoral pores, as in the last, but the trunk not bristled with groups of spines.

Uromastix, Cuv., have merely the head not swollen, and all the body-scales small, uniform, and smooth, but those of the tail are still larger and more spinous than in restricted *Stellio*, though there are none underneath it. A series of pores beneath the thigh.

THE AGAMAS (*Agama*, Daud.)—

Have a great resemblance for the restricted Stellions, especially in the bulging of the head; but their imbricated and not verticillated caudal scales distinguish them. The maxillary teeth are nearly the same, and there are none on the palate. In

The Ordinary Agamas, the scales, raised into points or tubercles, are alike bristled on various parts of the body, and especially round the ear, into spines that are sometimes grouped, and sometimes isolated. Occasionally, there is a range round the neck, but they never form the crest which characterises the Galeotes. The skin of the throat is lax, folded across, and susceptible of inflation. Some only have femoral pores.

The Tapays are merely Agamas, which, with a swollen belly, have a short and slender tail.

Trapelus, Cuv., have all the scales small and spineless, and no femoral pores. That of Egypt changes colour as readily as the Chameleon.

Leiolepis, Cuv., has the head less swollen, and is wholly covered with small and smooth serrated scales. It has femoral pores.

Tropidolepis, Cuv., is uniformly covered with square, imbricated scales, and has the series of femoral pores strongly marked.

Leposoma, Spix., differs only from the last in the absence of the pores.

The Galeotes, (*Calotes*, Cuv.), are regularly covered with imbricated scales, often square and pointed, over the whole body, limbs, and tail, which last is very long; those of the middle of the back being more or less raised and compressed into spines, forming a crest of varying length.

Lophyrus, Dumeril, have a compressed tail, and dorsal crest still higher than in the last, from which they differ in possessing femoral pores.

Gonocephalus, Kaup., have also a sort of disc on the skull, formed by a crest which terminates by a dentelation before each eye. They likewise have a throat-appendage and nuchal crest. The tympanum is visible.

Lyriocephalus, Merrem, conjoin to the characters of *Lophyrus* that of having the tympanum couched under the skin and muscles, as in the Chameleons. They have also a dorsal crest and keeled tail.

Brachylophus, Cuv., have small scales, a nuchal and dorsal crest but slightly projecting, a small throat-appendage, femoral pores, and general aspect of the Iguanas; but no palatal teeth, and those of the jaws denticulated.

Physignathus, Cuv.—The head bulged backwards, without any throat-appendage, and a crest of great pointed scales along the back and tail, which last is much compressed.

THE ISTIURES (*Istiurus*, Cuv.; *Lophura*, Gm.)—

Are characterized by a raised and trenchant crest, which extends over a part of the tail, and is sus-

tained by long spinous vertebral apophyses; this crest is scaly like the rest of the body; the belly and caudal scales are small, and approach a little to a square form; the teeth are strong, compressed, and undenticulated, and are found only on the jaws; there are femoral pores, and the skin of the throat is lax, without forming an appendage.

THE DRAGONS (*Draco*, Lin.)—

Are known at the first glance from all other Saurians, by their first six false ribs, instead of encircling the abdomen, being extended in a straight line, so as to support a production of the skin, which forms a sort of wing, and acts as a parachute when the animal leaps from bough to bough. They are small-sized reptiles, everywhere covered with minute imbricated scales, those of the tail and limbs being keeled. Their tongue is fleshy, but slightly notched and little extensible. Beneath the throat is a long pointed [inflatable] appendage, sustained by the hyoid bone, and laterally by two other small bones. The tail is long; the thighs have no pores; and there is a slight dentelation on the neck. Each jaw has four small incisors, flanked by a long and pointed canine, behind which are a dozen triangular and trilobate molars.

They have, therefore, the scales and throat-appendage of the Iguanas, with the head and teeth of the Stellions. All the known species are from the East Indies.

Sitana, Cuv., differs in the non-prolongation of the ribs, and by having an enormous throat-appendage, which reaches to the middle of the belly, and is more than double the height of the animal.

It is perhaps to this tribe of Agamas that we should approximate a most extraordinary fossil reptile, the remains of which are imbedded in the Jura limestone,—

THE PTERODACTYLUS, Cuv.

It had a very short tail, a very long neck, and very large head; the jaws armed with even and pointed teeth; but its principal character consisted in the excessive elongation of the second toe of its fore-feet, which extended twice the length of the trunk, and probably [undoubtedly] served to sustain some membrane by which the animal was enabled to fly, similar to that which the ribs of the Dragon support.

The second section of the family of Iguanas, or that of the Iguanas proper, is distinguished from the preceding by the existence of palatal teeth.

THE IGUANAS, properly so called, (*Iguana*, Cuv.)—

Have the body and tail covered with small imbricated scales; a range of spines along the back, or of raised, compressed, and pointed scales, and under the throat a compressed and pointed appendage, the edge of which is sustained by a cartilaginous production of the hyoid bone. The thighs have the same range of porous tubercles as in the Lizards proper, and their head is covered with plates; each jaw is surrounded by a range of triangular, compressed teeth, with denticulated edges; and there are also two little ranges at the back of the palate.

A species common in all tropical America (*Lac. iguana*, Lin.), which grows to four or five feet in length, is esteemed very fine eating, though hurtful in syphilitic disorders. It lives chiefly upon trees, occasionally enters the water, and subsists on fruit, grain, and leaves. The female deposits eggs in the sand as large as those of a Pigeon, which are agreeable to the taste, and almost without white. Several others inhabit the same countries.

OPHRYESSA, Boié.

Small imbricated scales, a slightly projecting dorsal crest prolonged over the compressed tail, palatal teeth, and denticulated maxillary teeth which approximate it to the Iguanas, but no throat-appendage nor femoral pores.

THE BASILISKS (*Basiliscus*, Daud.)

No femoral pores, but palatal teeth as in the last; the body covered with small scales; and a continuous elevated crest along the back and tail, which supports spinous vertebral apophyses as in the tail of *Istiurus*.

THE MARBLETS (*Polychrus*, Cuv.)—

Have palatal teeth, and femoral pores, like the Iguanas, but which are inconspicuous: their body, however, clad with small scales, is not crested; the head is covered with plates; tail long and sharper-edged; the throat extensile, forming an appendage at the will of the animal; and they change colour like the Chameleons, having a very voluminous lung, which fills nearly the whole body, and subdivides into numerous branches; their false ribs also surround the abdomen, as in the Chameleons, and unite to form complete circles.

THE ECPHIMOTES, Fitz.

Teeth and pores of the preceding, but small scales on the body only; those of the tail, which is thick, being large, pointed, and keeled; head plated; general form somewhat short and flattened, as in certain Agamis, rather than attenuated as in the Marblets.

OPLURUS, Cuv.,—

Differs from the last in wanting femoral pores, with keeled and pointed caudal scales, which approximate this group to the Stellions; the dorsal scales are also keeled and pointed, but very small.

THE ANOLIS (*Anolius*, Cuv.)—

To the general form of the Iguanas, and especially of the Marblets, conjoin a very peculiar distinctive character; the skin of their toes widening under the antepenultimate phalanx into an oval disk, striated across underneath, so as to attach to different kinds of surfaces, over which they creep with much facility by means of their very crooked claws. The body and tail are uniformly roughened with minute scales, and the greater number have a goitre-like appendage under the throat, which inflates and changes colour with the passions of the animal, and during the season of copulation. Several of them at least equal the Chameleon in the facility with which they vary the colours of their skin. Their ribs unite beneath into complete circles, as in the Chameleons and the Marblets. Their teeth, as in the Iguanas and Marblets, are trenchant and denticulated, and they have the same range of them on the palate. The skin of the tail wrinkles into slight folds, each containing some circular ranges of scales. This genus appears to be peculiar to America.

Some have a caudal crest sustained by spinous vertebral aphopyses, as in the Istiures and Basilisks; while others have a round tail, or which is only a little compressed.

It is to this family of Iguanians with palatal teeth, that the enormous fossil reptile of Maestricht appertains, to which the term *Mososaurus* has been applied; the *Geosaurus* of Soemmering, also, the *Megalosaurus* of Buckland, and the *Iguanodon* of Mantell, with certain others, all of immense size, appear to approximate this same family; but their characters are not sufficiently known to class them with certainty.

THE FOURTH FAMILY OF THE SAURIANS,—

THE GECKOTIANS,—

Consists of nocturnal species, so similar that they may be all left under a single generic head,—

THE GECKOS, Daud. (*Stellio*, Schneider.; *Ascalabotes*, Cuv.).

These have not the attenuated form of the Lizards already treated of, but, on the contrary, are flattened, more particularly on the head, and have the feet of mean length, and the toes nearly equal; their gait is slow and stately; their very large eyes, the pupil of which shrinks from the light, as in the Cats, indicate them to be nocturnal creatures, which pass the day in obscure places; their very short eyelids retreat altogether between the eye and orbit, which imparts a different physiognomy from that of other Saurians; their fleshy tongue is not extensible; their tympanum a little deepened; their jaws are armed all round with one range of minute serrated teeth; their palate toothless; their skin is roughened above with minute granular scales, among which are often some larger tubercles, and is covered on the under parts with somewhat less diminutive flat and imbricated scales. Some have femoral pores. The tail has circular folds, as in the Anolis; but, when it has been severed, it is reproduced without folds, and even without tubercles, which has led to a multiplication of the species.

This genus is very numerous, and is diffused over the hot regions of both continents. Their tardy and sombre aspect imparts a certain resemblance to the Toads and Salamanders, and have hence caused them to be disliked, and accused of being venomous without any proof that they are so.

The greater number have the tarsi widened throughout or in part, and marked underneath with very regular folds of the skin, which enable them to adhere to surfaces, so as to walk even on ceilings. Their claws are variously retractile, and preserve their sharp points; which circumstance, in conjunction with their eyes, has led to their being compared to the Cats among mammiferous animals; these claws, however, vary in number according to the species, and in some are wanting altogether.

The first and most numerous subdivision of the Geckos, which I name *Platydactyles*, have toes widened throughout their length with transverse scales underneath; some have claws on all their toes, and very small thumbs. They are handsome animals, with bright colours, and are entirely covered with tubercles. The different known species inhabit the Mauritius. There are some with femoral pores, and others without, and among the latter some with fewer or no claws.

A second subdivision is formed of the *Hemidactyles*, which have an oval disk at the base of their toes, formed by a double range of chevron scales underneath; the middle of this disk elevates the second phalanx, which is slender, and bears the third, with its claw, at the extremity. The known species have all five claws, and the range of pores on either side of the anus; the scales underneath the tail form broad bands, as in the true Serpents.

A third subdivision, which I style *Thecadactyles*, have toes widened throughout their length, and furnished with transverse scales underneath, but which latter are divided by a deep longitudinal groove, into which the claw retracts completely. Those known to me have the thumb alone clawless, no femoral pores, and the tail covered with little scales both above and below.

The fourth subdivision of Geckos, I term *Ptyodactyles*. These have only the ends of their toes dilated into plates, with a fan-like structure beneath; the middle of the plate being split, and the claw placed in its fissure. They have very crooked claws on all their toes.

Some have a round tail, and five toes; while others have the tail bordered with a membrane on each side, and the toes palmated. It is probable that the latter are aquatic, and they are the *Uroplates* of Dumeril.

A fifth subdivision is composed of the *Spheriodactyles*,—which are certain small Geckos, the ends of the toes of which are terminated by a little palette without folds, but the claws of which are always retractile. Those in which the palette is double, or emarginated in front, approximate the round-tailed Ptyodactyles. More frequently, however, the palette is round and simple. All the known species are from India and the Cape.

Finally, there are certain of these Saurians which, with all the other characters of the Geckos, have the toes not widened. Their claws, five in number, are nevertheless retractile. Some of these, with a round tail, and the toes striated beneath, having dentelated edges, constitute the *Stenodactyles*;—and there are others with slender and naked toes, and also a round tail, which are the *Gymnodactyles* of Spix.

Some, again, have the tail horizontally flattened, in the form of a leaf, which I denominate *Phillurus*.

One species only is as yet known, from New Holland.

THE FIFTH FAMILY OF THE SAURIANS,—

THE CHAMELEONS (*Chamæleo*, Lin.),—

Are so very distinct from the other Saurians that it is not easy to intercalate them in the series.

All have the skin roughened with little scaly granules; the body compressed, and the dorsal line sharp; tail round and prehensile; five toes on each foot, but divided into two opposite sets, one consisting of two toes, and the other of the remainder,—the toes of each of these sets being connected by skin as far as the nails; the tongue is fleshy, cylindrical, and extremely protrusile; the teeth trilobate; the eyes large, but almost covered by the skin, which leaves only a little aperture opposite the pupil, and they are moveable independently one of the other; the ear not visible externally, and the occiput pyramidically raised. Their first ribs are joined to the sternum, and the remainder are each continued to join the corresponding rib of the other side, encircling the abdomen by complete hoops. The lung is so vast that, when inflated, the body appears transparent, and induced the ancients to believe that these animals fed upon air. They subsist on insects, which they take with the glutinous extremity of the tongue, which organ is the only part of them that moves quickly. The motion of the limbs is excessively slow. The magnitude of the lung is probably the indirect cause of their changing colour, which does not take place, as is currently supposed, for the purpose of assimilating them to the proximate surfaces, but according to their wants and passions. Their lung, in fact, renders them more or less transparent, by forcing the blood more or less into the vessels of the skin, the colour even of this fluid being more or less vivid according as the lung is distended with air. They are constantly found upon trees.

[These most singular animals are particularly remarkable for the diminished sympathy of the two sides of their whole frame, one of which may be asleep and the other awake, one of one colour and the other of another, &c.,—the separate movement of their eyes being merely another phase of the same phenomenon: hence it is remarkable, that, unlike most other animals, the Chameleon is totally unable to swim, from the incapability of its limbs of acting in due concert.]

THE SIXTH FAMILY OF THE SAURIANS,—

THE SCINDOIDIENS,—

Are recognized by the shortness of their feet, the non-extensibility of the tongue, and the equality of the tile-like scales which cover the whole body and tail.

THE SCINQUES (*Scincus*, Daud.)—

Have four very short feet, a body of nearly the same calibre with the tail, no occipital bulge, no crest or throat appendage, and the scales uniform and shining, and disposed tile-fashion like those of a Carp.

Some have a spindle-shape; and others, which are nearly cylindrical, and more or less elongated, resemble Snakes, and more particularly the Orvets (*Anguis*), with which they have many internal points of relationship, and which thus grade from the family of Iguanas by an uninterrupted series of transitions. For the rest, the tongue of this genus is fleshy, and but slightly extensible and notched; and the jaws are armed all round with small serrated teeth. The remainder of their conformation approximates more or less to that of the Iguanas and Lizards, and all their toes are unguiculated and free. Certain species have palatal teeth, and a dentelated anterior border to the tympanum, while others (the *Tiliqua*, Gray) have no teeth to the palate.

THE SEPS (*Seps*, Daud.)—

Merely differ from the Scinques by having the body still more elongated, almost like that of an Orvet, and the feet still smaller, the fore and hind being also more separated from each other. Their lungs begin to exhibit some irregularity.

THE DIPODES (*Bipes*, Lacep.)—

Compose a small genus, which only differs from Seps by the total absence of anterior limbs, merely retaining the scapulars and clavicles buried beneath the skin, and the hind feet alone being visible. There is but one step from them to the Orvets. Some have a range of pores on each side of the anus, which is not found in others.

THE CHALCIDES (*Chalcis*, Daud.)—

Are very elongated and snake-like Lizards, like the Seps; but their scales, instead of being disposed tile-fashion, are rectangular, and form transversal bands on the tail, like those of ordinary Lizards.

Some have a groove along each side of the trunk, and the tympanum still very apparent. They approximate the Cordyles, as the Seps do to the Scinques, and lead, in a variety of ways, to the Pseudopodes and Ophisaurs. Others have a concealed tympanum, and conduct to the Chirotes, and thence to the Amphisbænes.

THE CHIROTES (*Chirotes*, Cuv.)—

Resemble the last by their verticillated scales, and still more the Amphisbænes, by the obtuse form of the head; but are distinguished from the former by the absence of hind feet, and from the latter by the existence of fore-feet.

The only species (*C. lumbricoides*) inhabits Mexico, and has all the internal organization of an Amphisbæne, with femoral pores, and one great lung and the vestige of a second, as in most Ophidians.

In fact, the genera which terminate this order of Saurians interpose in so many ways between the ordinary Saurians and the genera placed at the head of the Ophidians, that many recent naturalists object to separating the two orders, or at least establish one comprised of the Saurians in part, detaching the Crocodiles, and another of the Ophidians pertaining to the family of *Anguis;* but among the fossils of the ancient limestone formations are found two very extraordinary extinct genera, which, with the head and trunk of a Saurian, have feet borne on short limbs, and composed of a multitude of little articulations, which form in the aggregate a sort of fin or swimming-paw, analogous to those of Cetaceans. The first of these genera, or that of

THE ICTHYOSAURUS,—

Had a large head and short neck, enormous eyes, middle-sized tail, and elongated jaws armed with conical teeth, inserted in a groove.

Several species are found in England, France, and Germany, some of immense size.

The other genus, or

THE PLESIOSAURUS,—

Had a small head, and extremely long serpent-like neck, composed of more cervical vertebræ than that of any other known animal. Its tail was short, and its remains are found in the same calcareous strata.

These two genera, for a knowledge of which we are principally indebted to the researches of Messrs. Home, Conybeare, Buckland, &c., were inhabitants of the sea. They should form a very distinct family, but what is known of their osteology approaches more to that of the ordinary Saurians than the Crocodiles, with which latter they have been gratuitously associated by M. Fitzinger, since neither their tongue nor scales are known, which are the two most distinctive characteristics of the *Loricata.* [It has since been ascertained that they were covered merely with skin, apparently as in the Batrachians; and there is reason to suspect that the Icthyosaur possessed a cartilaginous dorsal fin, as in many of the true *Cetacea*]

THE THIRD ORDER OF REPTILES.

THE SERPENTS (OPHIDIA).

These have no feet, and are consequently, of all others, the *Reptiles* which most merit the name. Their extremely elongated body progresses by means of folds pressed backwards against the ground. They divide into three families.

THE FIRST FAMILY OF OPHIDIANS,—

THE ORVETS—

Retains the skull, teeth, and tongue of the preceding group of *Seps*, and the eye has three lids, &c. whence they are merely Seps without feet. Such are

THE ORVETS (*Anguis*, Lin.),—

Externally characterized by imbricated scales, which cover them all over. We subdivide them into four subgenera, the three first of which have a shoulder-bone and pelvis beneath the skin.

The Pseudopodes (*Pseudopus*, Merrem) have the tympanum visible externally, and a small prominence on each side of the anus, which contains an ossicle analogous to a femur, articulated to a true pelvis beneath the skin; the anterior limbs are only represented by an inconspicuous depression, and have no internal humerus. One of the lungs is a fourth shorter than the other. The scales are square, thick, and semi-imbricated, and between those of the upper and lower parts is a groove of smaller scales on each side.

The Ophisaurs (*Ophisaurus*, Daud.), merely differ in the absence of external rudiments of limbs, but retain the tympanum, and have one lung a third shorter than the other.

The Orvets (*Anguis*, Cuvier), have no trace of limbs externally visible, and their tympanum even is couched beneath the skin; their maxillary teeth are crooked and compressed, and they have none on the palate. The body is surrounded with imbricated scales, without any lateral fold, as in the preceding; and one of the lungs is shorter by half than the other. [A species, known as the *Slow-worm*, or *Blind-worm*, is of common occurrence in Britain, and throughout Europe. When alarmed, it constricts its muscles, and is then singularly brittle.]

These three subgenera have still an imperfect pelvis, a small sternum, scapulars, and also clavicles, hidden beneath the skin; and the absence of these several bones characterizes

The Acontias (*Acontia*, Cuv.), which, in the structure of their head and eye-lids, still resemble the preceding; their anterior ribs are connected all round, beneath the trunk, by cartilaginous prolongations; and they have one middle-sized lung, and another very short one. Their teeth are small and conical, and I think that I have perceived some on the palate. They are easily known by having the muzzle closed by a sort of mask.

THE SECOND FAMILY OF OPHIDIANS,—

THE TRUE SERPENTS,—

Which is much more numerous, is composed of genera with neither sternum nor vestige of shoulder, but the ribs of which still encircle a great part of the trunk, and the vertebræ are still articulated by a convex facet applied to a concave facet of the succeeding one. They have no third eyelid, nor tympanum; but the small bone of the ear exists beneath the skin, and its handle passes behind the tympanic bone. Several have also, under the skin, a vestige of hind-limbs, which in some even shows itself externally in the form of a small hook.

We subdivide them into two tribes.

That of the DOUBLE-MARCHEURS [which progress either head or tail foremost,] have still the lower jaw fixed as in all the preceding Reptiles, by a tympanic bone, articulated direct to the cranium, the two rami of this jaw anchylosed at the symphysis, and those of the upper fixed to the skull, and to the intermaxillaries; so that their swallow cannot dilate as in the following tribe, and their head is of even size with their whole body; a form which enables them to progress backwards or forwards with the same facility. The bony frame of the orbit is incomplete behind, and the eye is very small. Finally, their body is covered with scales, the anus very near its extremity, the trachea long, and the heart placed far backwards. None of them is known to be venomous.

There are two genera, one of which approximates to the Chalcides and Bimanes, and the other to the Orvets and Acontias.

THE AMPHISBÆNES (*Amphisbæna*, Lin.)—

Have the whole body surrounded with circular ranges of square scales, as in the Chalcides and Bimanes

among the Saurians; a range of pores before the anus; the teeth few, conical, and growing only from the jaw, none from the palate; and they have only one lung.

There are three or four species, which live on insects, and are found principally about ant-hills, a circumstance which has induced the opinion that they subsist chiefly upon Ants. They are oviparous.

THE TYPHLOPS (*Typhlops*, Schneider)—

Have the body covered with small imbricated scales, like the Orvets, with which they were long arranged; the muzzle prolonged and plated; the tongue rather long and forked; the eye reduced to a point, scarcely visible through the skin; the anus nearly at the extremity of the body; and one lung four times as large as the other. They are small species, resembling Earth-worms at the first glance, and are found in the hot regions of both continents.

Some have the head obtuse and even with the body, resembling packthread at both ends. Others have the muzzle depressed and obtuse, with scaly plates anteriorly. Some, again, have the fore-part of the muzzle covered with a single broad plate rather sharp in front. And there are others in which the muzzle terminates in a little conical point, being also totally blind: the posterior extremity of these is enveloped in a bony oval buckler, and they were formerly ranged with the Orvets, on account of their small scales.

The other tribe, or that of the SERPENTS properly so called, have a tympanic bone or pedicle to the lower jaw, which is moveable, and nearly always suspended by another bone analogous to the mastoid, which latter is attached to the skull by muscles and ligaments, that allow it also to be moveable. The branches of this jaw are not united together, and those of the upper are connected by ligaments only to the intermaxillaries; so that they can open more or less, which imparts to these animals the capability of dilating the mouth, so as to swallow objects of greater bulk than themselves.

Their palatal arches partake of this mobility, and are armed with recurved and pointed teeth, which is the most marked and constant character of this tribe; their windpipe is very long; the heart placed far backward; and the greater number have only one great lung, with the vestige of a second.

They divide into venomous and non-venomous, and the former of these into venomous having several maxillary teeth, and into venomous with isolated fangs.

In the non-venomous, the branches of the upper jaw are furnished throughout their length, like those of the lower jaw and the palate, with fixed and solid teeth. There are three or four subequal ranges of these teeth in the upper part of the mouth, and two in the lower.* Those among them which have the mastoid bones inclosed within the cranium, the orbit incomplete behind, the tongue short and thick, and which resemble the *Double-Marcheurs* in the cylindrical form of their head and body, were formerly classed with the Orvets, on account of their diminutive scales.

THE ROLES (*Tortrix*, Oppel; *Torquatrix*, Gray; *Ilysia*, Hemp.),—

Are externally distinguished from the Orvets by the range of scales along the belly and beneath the tail being rather larger than the others, as also by the extreme shortness of the tail. They have but one lung. All are from America.

The *Uropeltis*, Cuv. (*Anilius*, Oken), is an allied new genus, the tail of which, still shorter and obliquely truncated above, is flat and beset with little scales at the truncation. Their head is very small; the muzzle pointed; they have a range of scales under the tail, a little larger than the rest, and a double range beneath its truncate portion.

The non-venomous Serpents which, on the contrary, have detached mastoid bones, and the jaws of which are dilatable, have the occiput more or less bulged, and the tongue forked and very extensible.

Two principal genera have long been distinguished,—the Boas and the Snakes proper.

THE BOAS (*Boa*, Lin.),—

Formerly comprehended all Serpents, venomous or not so, the under-part of the body and tail of which is covered with scaly transverse bands, each of a single piece, and which have neither spur nor rattle at the tip of the tail. Being very numerous, it is necessary to subdivide them, after abstracting the venomous ones.

* The common opinion is, that all Serpents destitute of pierced fangs in the lower part of the jaw, are non-venomous; but this I have some reason to doubt. All have a maxillary gland, often very large; and the back-molars frequently exhibit a groove, which would seem to conduct some liquor. This much is certain, that various species, the back-molars of which are very large, are reputed to be extremely venomous in the countries which they inhabit; an opinion which is confirmed by the experiments of Lalande and Leschenauld, which it is desirable should be repeated.

The Boas more particularly so named, have a hook on each side of the anus; a compressed body, larger towards the middle; a prehensile tail; and small scales, at least on the hinder part of the head. Among them are found the largest of all Serpents, certain species attaining a length of thirty or forty feet, and being capable of swallowing Dogs, Stags, and even Cattle, at least according to some narrators, after having crushed them within their folds, lubricated them with their saliva, and enormously dilated their jaws and gullet. This operation lasts a long while. A remarkable particular of their anatomy consists in their having one lung but half shorter than the other. [At the extremity of the great lung in all this tribe is an extremely capacious air-bag, the use of which appears to be for containing the air requisite for respiration, when the nostrils are closed by the tedious process of deglutition.] We subdivide these Serpents according to the teguments of the head and jaws.

Some have the head covered as far as the tip of the muzzle with small scales resembling those of the body, and the plates which invest the jaws are not furrowed with grooves. Others have scaly plates beneath the eyes as far as the muzzle, and no furrows to the jaws. Some, again, have scaly plates upon the muzzle, and grooves upon those of the sides of the jaws. There are some with plates on the muzzle, and the sides of the jaw hollowed into a slit-like chink beneath the eye and further backward. And, lastly, some have no furrows, and the muzzle invested with plates but slightly prominent, which are obliquely cut backwards in front and truncated at the tip, so as to terminate in corners: these have the body much compressed, and the back keeled. They inhabit the East Indies whereas the others are from America, and should form a distinct subgenus—*Cenchris*, Gray.

THE SCYTALS (*Pseudoboa*, Schneider).

Plates, not only on the muzzle, but over the cranium, as in the Snakes proper; no grooves, the body round, and head even with the trunk, as in the Roles.

Daudin has likewise separated

THE ERYX,—

Which differ by having a very short obtuse tail, and by their ventral plates being narrower. The head is short and nearly even with the body, characters in which they approximate the Roles, were it not that the conformation of their jaws permitted these to distend. The head is covered with small scales; and they have also no hooks near the anus.

THE ERPETONS, Lacepede,—

Are very remarkable for having two soft prominences covered with scales, at the tip of the muzzle; head plated; the plates of the belly not very wide, and those of the under-part of the tail different from the other scales. Their tail, however, is long and pointed.

THE SNAKES Proper (*Coluber*, Lin.)—

Comprehended all the species, venomous or non-venomous, the plates underneath the tail of which are divided each into two, or, in other words, ranged in pairs.

Independently of the subtraction of the venomous kinds, their number is so vast that we are obliged to have recourse to all sorts of characters in order to distinguish them. First, are separated

THE PYTHONS, Daudin,—

Which have hooks near the anus, and narrow ventral plates, as in the Boas, from which they only differ by having the plates underneath the tail double. Their head is plated at the tip of the muzzle, and their lips grooved. Species occur as large as any Boa.

Some of these Pythons have the first, and others the terminal plates of their tail, simple; but these are perhaps accidental varieties.

The *Cerberi*, like the true Pythons, have the head entirely covered with small scales, with the exception of plates between and before the eyes; but they have no hooks near the anus. They have sometimes also simple plates at the base of the tail.

Xenopeltis, Reinwardt; have great imbricated triangular plates before the eyes, which might be confounded with the scales adjacent to them, only that the latter are smaller.

Heterodon, Beauvois.—The ordinary plates of this group, but the tip of the muzzle composed of a short single piece, in form a trihedral pyramid, which is a little raised and erected above, a conformation which has induced the appellation of pig-snouted Serpents.

The *Hurria*, Daud.—Indian species, with subcaudal plates always simple, except those at the point, which are double; these trivial anomalies, however, merit but little notice.

The Dipsas of Laurenti (*Bungarus*, Oppel.)—Body compressed, and very much larger than the head: the range of scales along the spine of the back larger than the others.

Dendrophis, Fitzinger; *Ahætulla*, Gray.—Resemble the last by having a range of broader scales along the back, and narrower scales along the flanks; but their head is not wider than the body, which is slender and very much lengthened. Muzzle obtuse.

Dryinus, Merrem ; *Passerita*, Gray.—Body as long and slender as in the last, but a small and slender pointed appendage at the tip of the muzzle.

Dryophis, Fitzinger.—The same long filiform or cord-like body, but no appendage, and the scales of equal size.

Oligodon, Boié. Small species, with an obtuse, short, and narrow head, and no palatal teeth.

After all these dismemberments by different authors, there yet remain several which appear to me less worthy of adoption ; being founded on slight differences in the proportions of the head, the thickness of the trunk, &c. : and there is still left a group the most numerous of all in species, that of

The Snakes, as most restricted, which have no peculiar distinguishing character. Several of these are found in France, [and one only in Britain, the common Ring-necked Snake (*C. natrix* and *Natrix torquatus*), which attains to a yard in length, and feeds on Frogs, Mice, insects, &c.] It is eaten in some provinces of France. The exotic species are innumerable : some are remarkable for the splendour of their colours ; others for the regularity of the distribution of them ; many are quite uniform in their tints ; and a few only attain a very large size.

THE ACROCHORDUS, Hornstedt—

Are readily distinguished from the rest of this family by the uniformly small scales with which their body is covered both above and below.

The known species (*A. javensis*, Lac. ; *Anguis granulatus*, Schneider,) has each of its scales raised into three little crests, resembling, when the skin is very loose, three isolated tubercles. It grows to a large size. Hornstedt has stated that it subsists altogether on fruits, which in an animal of this kind would be very extraordinary.

The Venomous Serpents *par excellence*, that have isolated fangs, present a peculiar structure of the organs of manducation.

Their superior maxillary bones are very small, borne upon a long pedicle, analogous to the outer pterygoid apophysis of the sphenoid, and are also very moveable ; having a pointed tooth affixed to them, which is pierced by a small canal, through which issues a liquid secreted by a large gland beneath the eye. This liquid it is, instilled into the wound inflicted by the tooth, which poisons the bodies of animals, and produces effects more or less deadly, according to the species from which it is derived. The tooth lies down flat in a fold of the gum when the Serpent has no occasion for it, and behind it are several germs designed successively to replace it, in case it should be left in a wound. Naturalists have termed these venomous teeth *crochets mobiles* [or *fangs*], but it is properly the maxillary bone that moves. These Serpents have no other teeth besides the double range upon the palate.

All the venomous species of which we possess certain information, bring forth their young alive, the eggs hatching within the body of the parent, [though during the act of parturition]. It is thus that their general name of *Vipers* has arisen, which is a contraction of *viviparous*.

Venomous Serpents with isolated fangs, present nearly the same external characters as the preceding ; but the greater number have extremely dilatable jaws, and the tongue very extensile. Their head, which is wide posteriorly, has in general a savage aspect, which to a certain extent announces their ferocity. They form two principal great genera, the Rattle-snakes and the Vipers, of which the second has many subdivisions, around which some alien small ones require to be grouped.

THE RATTLE-SNAKES (*Crotalus*, Lin.)—

Are more celebrated than any other Serpents for the deadliness of their venom. In common with the Boa, they have simple transverse plates beneath the body and tail, but are most obviously distinguished by the rattling instrument which they carry at the tip of the tail, and which is formed of several scaly cornets loosely attached together, that move and rattle whenever the animal shakes or alters the position of its tail. It appears that the number of these cornets increases with age, and that they acquire an additional one at each casting of the skin. Their muzzle is hollowed by a little rounded depression behind each nostril. All the known species are from America. They are so much the more dangerous, as the season or climate is hotter ; but their ordinary habits are tranquil and sluggish. They move slowly, and only bite when provoked, or for the purpose of killing their prey. Although they do not climb trees, they nevertheless feed principally upon Birds, Squirrels, &c., which it was long believed they possessed the faculty of hallucinating or charming, so as to draw them by degrees to enter their throat. It would seem, however, that the fear which their appearance inspires occasions those disordered movements of their prey, which have given rise to the foregoing supposition.

Most of the species have the head scaled similarly to the back ; while others have great plates upon the head. We approximate

The *Trigonocephali* of Oppel (*Bothrops*, Spix ; *Cophias*, Merrem) ; which are distinguished by the absence of the rattle, but accord in their other characters. Some of these have simple subcaudal plates, as in the preceding,

and the head plated to the eyes; the tail terminated by a spur. Others have no subcaudal plates, and the head scaled like the back. Some have the head plated, with double subcaudal plates: and others conjoin to the latter character, excepting that the extremity of the tail has small scales both above and below, little scales upon the head also.

THE VIPERS (*Vipera*, Daud.),—

The greater number of which were confounded by Linnæus with the Snakes proper, on account of their double subcaudal plates, require to be separated from the latter by reason of their venomous fangs, and grade into other Serpents with single or partly double subcaudal plates, being distinguished from the Rattlesnakes and Trigonocephalets by the absence of cavities beneath their nostrils.

Some have only keeled and imbricated scales upon the head, like those of the back; and others have the head covered with small granulated scales, [among which is the Viper or Adder of this country]. Some again [the *Cerastes*] have a pointed bone over each eyebrow, [and are peculiar to Africa]. Others, which are similar in all other respects to the preceding generally, have three plates a little larger than the scales which surround them upon the middle of the head. There are some Vipers, also, with plates upon the head, like those of the Common Snake.

Naia—Are Vipers with plated heads, the anterior ribs of which can be dilated and thrown forward, so as to distend this part of the trunk into a disc more or less broad. The most celebrated species is the Cobra di Capella of India, with a spectacle-like mark on the disk, and which is extremely venomous. The Haje, or Asp, of Egypt, is another.

Elaps.—Head plated, and an opposite organization of the body to the Asps; their jaws even can scarcely widen, on account of the shortness of the tympanic bones, and especially of the mastoids, from which it results that the head is nearly of even size with the body, as in the Roles and Amphisbænes.

Micrurus, Wagner, has merely the tail shorter.

Platurus, Latreille.—Head also plated, and double plates beneath the tail; but the latter compressed like an oar, which renders them aquatic.

Finally, we place at the termination of the Vipers certain species which only differ in having single subcaudal plates, either partly or throughout. They are distinguished from the Tisiphones by having no cavities behind the nostrils.

Some, with entire plates at the base of the tail, compose the *Trimererurus*, Lacepede, having large plates on the head, and some of the subcaudal ones double, others single.

Oplocephalus, Cuv.—Have great plates on the head, and all the subcaudals single.

Acanthophis, Daud.; *Ophrias*, Merrem.—Plates in front of the skull and of the head, the tail terminated by a hook, and all its plates simple, though sometimes there are double ones at its extremity.

Echis, Merrem.—Small plates on the head, and all the subcaudals single.

Langaha, Bruguières.—Head plated; the muzzle pointed and projecting; anterior half of the tail encircled with entire rings, and the posterior with little imbricated scales both above and below.

Besides these two tribes of Serpents properly so called, which have been longer known, a third has been discovered more recently, the jaws of which are organized and armed nearly as in the non-venomous kinds, but which have, nevertheless, the first of their maxillary teeth longer than the rest, and pierced for the purpose of conducting venom, as in the genera with isolated fangs, already described.

These Serpents form two genera, distinguished from those of the two allied families, by the scaling of the belly and under-part of the tail.

THE BONGARS (*Pseudoboa*, Oppel.)—

Possess, like the Boas, the Rattlesnakes, and the Scytals, simple plates beneath the belly and tail. Their head is short, covered with large plates, and the occiput but slightly bulged. Their most characteristic distinction, however, consists in their very carinated back being furnished with a longitudinal range of scales, broader than the lateral ones, as in the Dipsas.

They inhabit the East Indies, where they are called *Rock Snakes*, one of the species attaining a length of seven or eight feet.

THE HYDRAS (*Hydrus*, Schneider, in part; *Hydrophis* and *Pelamides*, Daud.)—

Have the back part of the body and tail very much compressed and raised vertically, which, imparting to them the power of swimming, renders them aquatic animals. They are very common in certain parts of the Indian Seas, [and excessively venomous, feeding on fishes]. Linnæus ranged those that were known to him among the Orvets, on account of the small scales with which they are wholly covered. Daudin has subdivided them as follows:—

Hydrophis.—These have a range of scales a little broader than the rest under the belly, as in the Erpetons and Roles; the head small, not bulged, obtuse, and covered with large plates. Several species are found in the salt water of Bengal, and others in the Indian ocean.

Pelamides,—have, also, great plates on the head, but their occiput is bulged on account of the length of the

pedicles of their lower jaw, which is extremely dilatable; all their body-scales are equal, of small size, and disposed hexagonally. To these subgenera I have added that of

Chersydrus,—the head and body of which are equally covered with small scales.

THE THIRD FAMILY OF OPHIDIANS,—

THE NAKED SERPENTS,—

Comprises but one very singular genus, which several naturalists have deemed to belong rather to the Batrachians, although we are not aware that it undergoes any metamorphosis. It is that of

THE CŒCILIANS (*Cœcilia*, Lin.),—

So named on account of their excessively minute eyes, which are nearly hidden by the skin, and are sometimes absent altogether. The skin is smooth, viscous, and annularly wrinkled, appearing naked, although, upon dissection, some perfect though minute scales are discernible, which are regularly disposed in several transverse ranges between the wrinkles of the skin, and which we have detected, with certainty, in more than two species. The head is flattened, the anus round and nearly at the extremity of the body, the ribs much too short to encircle the trunk, the articulations of the vertebræ together are by conically hollow facets filled up with gelatinous cartilage, the same as in the Fishes and some of the lower Batrachians, and, in a slight degree, in the Amphisbænes only, among the other Ophidians; their maxillary bones cover the orbits, which are pierced by only a very small foramen, and the temporal bones extend over the fossa, so that the skull presents a continuous bony buckler above; their hyoid bone, composed of three pairs of arcs, induces the supposition that it originally supported gills. The maxillary and palate teeth are arranged in two concentric lines, the same as in the Proteans, but are often sharp and curved backward, as in the Snakes properly so called; the nostrils open behind the palate, and the lower jaw has no moveable pedicle, the tympanic bone being encased, together with the other bones, in the buckler formed by the skull.

The auricle of the heart of these animals is not divided so deeply as to be considered double, but their second lung is as small as in the other Serpents; the liver is divided into a great number of transverse laminæ. In their intestines have been found vegetable matter, together with soil and sand. Their ear has merely a small plate upon the oral orifice, the same as in the Salamanders.

Some of them have an obtuse muzzle, lax skin, very deep wrinkles, and two small ciliæ near the nostrils; as *C. annulata* of Brazil, which is found in marshy places several feet under ground, *C. glutinosa* of Ceylon, &c.; while others have the folds of the skin nearly obsolete, a very long slender body, and projecting muzzle. One of these is totally blind, the *C. lumbricoides*, Daudin; it is of a blackish colour, two feet long, and no thicker than a goose-quill.

THE FOURTH ORDER OF REPTILES,—

THE BATRACHIANS,—

Have but one auricle and one ventricle to the heart, [an assertion disproved by Professor Owen]. Their two lungs are always equal, and when young they conjoin to these, gills, which give them a relationship with the class of Fishes, and which are borne on the sides of the neck, upon the cartilaginous arches which support the hyoid bone. The greater number lose these gills, together with the supporting apparatus of them, upon attaining the perfect state: three gener only, the Syrens, Protei, and Menobranchi, retaining them at all ages.

During the period of the retention of the gills, the aorta, on proceeding from the heart, divides into a number of branches upon each side, corresponding to that of the gills; the blood from the gills returning through veins which unite together towards the back, into a single arterial trunk, as in Fishes: this trunk, or the veins which form it more directly, supplies the greater number of arteries which nourish the body, and even the vessels which conduct the blood for respiration into the lungs. But in the species which shed their gills, the vascular ramifications that communicate with them become obliterated, excepting two, which unite together to form a dorsal artery, each giving off a small branch to the lung of its particular side so that the circulation of a Fish becomes thus converted into that of a Reptile.

These animals have neither scales nor carapace, but the body is invested with a naked [and moist] skin, [over the surface of which the blood receives much of its oxygenation.] With the exception of one genus, they have no nails to the toes.

The envelope of their eggs is simply membranous, and in most cases these are fecundated as they issue forth, the male attaching himself to the other sex in order to be simultaneous.

Their eggs or spawn enlarge very much in the water after they have been laid. The young not only differs from the adult by the presence of its gills, but its feet are only developed by degrees, and in several genera there are also a deciduous beak and tail, and intestines of a different form. Some of the species are even viviparous.

THE FROGS (*Rana*, Lin.)—

Have four legs and no tail in their adult state. Their head is flat, the muzzle rounded, the mouth deeply cleft, and the greater number have a soft tongue attached only to the lower part of the gullet, but which extends forward to the jaw, and is doubled back above. Their fore-feet have only four toes, but the hinder sometimes show the rudiment of a sixth.

Their skeleton is entirely deprived of ribs. A cartilaginous plate, even with the head, takes the place of tympanum, and renders the ear visible externally. The eye has two fleshy lids, and a third, which is horizontal and transparent, concealed by the lower one.

The inspiration of air is produced simply by the movements of the muscles of the throat, which, by dilating, draw in the air through the nostrils, and, by contracting, whilst the orifices of the nostrils are closed by means of the tongue, force the air into the lungs. Expiration, on the contrary, is effected by the contraction of the muscles of the lower belly: so that, by opening the belly of the living animal, the lungs will distend without any power of contraction, and by holding open the mouth the animal will become asphyxiated, for want of air sent into the lungs.

The embraces of the male are excessively prolonged: in reference to which the thumb of this sex is furnished with a spongy swelling, which enlarges during the season, and which is designed to aid in grasping. The eggs are fecundated at the moment they are laid, and the young is termed a *tadpole*. It is at first provided with a long fleshy tail, and a small horny beak, but with no other apparent members besides certain little fringes at the sides of the neck. These disappear after some days, but Swammerdam assures us that they still exist as gills underneath the skin. The latter are minute crests, which are very numerous, attached to the four cartilaginous arches placed on each side of the neck adhering to the hyoid bone, and enveloped by a membranous tunic, which is covered by the general skin. The water, entering by the mouth, to bathe the intervals of these cartilaginous arches, passes out either by two orifices or by a single one, according to the species, pierced through the external skin, either on the middle or on the left side of the animal. The hind feet are gradually developed to view, by little and little, while the anterior likewise appear beneath the skin, but do not burst it for some time later. The tail is absorbed by degrees. The beak falls, and occasions the genuine mandibles to appear, which had previously been soft, and were concealed underneath the skin. The gills shrink and are obliterated, leaving the lungs to perform their functions unassisted by them. The eye, which in the Tadpole was only visible through a thinner space in the skin, becomes apparent with its three lids. The intestines, previously very long, slender, and spirally contorted, shorten, and acquire the enlargement of stomach and colon: the Tadpole living solely upon aquatic vegetation, whilst the adult animal preys on insects and other animal substances. Finally, the limbs of the Tadpole reproduce the parts of them that had been mutilated, nearly as in the Newts.

The particular epoch of each of these several charges varies, according to the species.

In temperate and cold climates, the perfect animal buries itself, during winter, under ground, or in the mud below the surface of water, where it continues to live without food or respiration, [beyond what of the latter is effected by the surface of the skin]; although, during the warm season, if it be held for a few minutes only with the mouth open, so as to impede the process of respiration, it perishes.

THE FROGS, properly so called, (*Rana*, Laurenti),—

Have a slender body, and the hind limbs very long, and more or less palmated; their skin is smooth and slippery; their upper jaw supplied all round with a range of minutely fine teeth, and they have an

interrupted range across the middle of the palate. The males have, on each side, under the ear, a delicate membrane, which is inflated with air when they croak. These animals both swim and leap with celerity.

[One only (*B. temporaria*) is indigenous to the British Isles.]

Ceratrophrys, Boié,—are Frogs with a broad head, the skin wholly or partly granulated, and a horn-like membranous prominence over each eyelid.

Dactylethra,—South African species, with pointed toes, those of the hind-feet broadly palmated, and the three internal having their extremities enveloped by a conical nail, of a black horny substance.

Hyla, the Tree-Frogs,—differ in no respect from the common ones, excepting that the extremity of each of their toes is widened and rounded into a sort of viscous palette, which enables them to adhere to the surfaces of bodies, and to climb trees, to which last they resort, during the summer, in pursuit of insects; but they deposit their eggs in water, and penetrate into the mud in winter, like other Frogs. Several species are decked in the gayest colours.

THE TOADS (*Bufo*, Laurenti)—

Have the body thick and squat, and covered with tubercles, with a large swelling pierced with pores behind each eye, from which a fetid milky secretion is expressed; no teeth whatever; and the hind limbs but little elongated. They leap badly, and are generally found at a distance from water. They are animals of hideous, disgusting form, the saliva of which has been erroneously considered venomous, as also their teeth, their supposed urine, and even the moisture which exudes from the skin; [the latter being, in fact, absorbed by the skin, for the purpose of cutaneous respiration, often in great quantity, so that the animal, when seized and taken up, lightens itself by discharging a quantity of this from the anus.]

[Two species are found in Britain, viz., the Common Toad (*B. vulgaris*), which progresses more by leaping than crawling; and the Natterjack (*B. calamita*), an inhabitant of heaths and commons in the south of England, which has a yellow mesial stripe along the back, never leaps, but creeps with considerable celerity, and utters a chirping cry. Its appearance is less unprepossessing than that of the other.]

Bombinator, Merrem,—only differs from *Bufo* by having the tympanum concealed beneath the skin.

Rhinella, Fitzinger; *Oxyrhynchus*, Spix,—has the muzzle pointed anteriorly.

Atilophus, Cuv.—Muzzle angular, and a crest on each side of the head, extending round the parotid.

Breviceps, Merrem; *Engystoma*, Fitzinger, in part.—No tympanum nor parotid visible externally, an oval body, the head and mouth very small, and feet but slightly palmated.

Pipa, Laur.—The body horizontally flattened; head large and triangular; tongue wholly wanting; tympanum concealed beneath the skin; small eyes placed towards the margin of the upper jaw; each of the front toes split at the tip into four little points; lastly, an enormous larynx in the male, formed as a triangular bony box, within which are two moveable bones which can close the entrance of the bronchi.

The longest known species (*R. pipa*, Lin.) inhabits the obscure nooks of houses in Cayenne and Surinam, and has a granulated back, with three longitudinal ranges of larger granules. The male places the eggs of the female upon her back, where they are fecundated, upon which the female returns to the water, the skin of her back swelling so as to form a number of cells, which inclose each of the eggs, and wherein the young pass their tadpole state, until they have lost their tails, and developed their limbs, at which time the mother returns to land.

THE SALAMANDERS (*Salamander*, Brong.)—

Have an elongated body, four limbs, and a long tail, which give them the general form of Lizards, whence Linnæus left them in that genus; but they have all the characters of Batrachians. Their head is flattened; the ear concealed entirely by the flesh, having no tympanum, but merely a little cartilaginous plate over the *fenestrum ovale;* both jaws furnished with numerous minute teeth; two longitudinal ranges of equal teeth on the palate, but attached to the bones that represent the vomer; tongue as in the Frogs, no third eyelid; a skeleton with three small rudiments of ribs, but no bony sternum; a pelvis suspended by ligaments to the spine; four toes before, and nearly always five behind. They respire, in the adult state, in the same manner as the Frogs and Tortoises. Their tadpoles breathe at first by gills in the form of crests, to the number of three on each side of the neck, which are subsequently obliterated, and which are suspended to cartilaginous arches, that form portions of the hyoid bone of the adult. A membranous operculum covers these apertures; but the gill-crests are never inclosed within a tunic, but float loosely. Their fore-feet are developed before the hind, and the toes appear successively.

The terrestrial species (*Salamandra*, Laurenti) have, in the perfect state, a round tail, and only remain in the water during their state of Tadpole, which endures but for a brief period, and when they resort to that element to breed. Their eggs are inclosed in an oviduct. Those of Europe have, on each side of the occiput, a gland analogous to that of the Toads.

The Aquatic Salamanders (*Triton*, Laurenti) permanently retain the vertically-compressed tail, and pass nearly their whole lives in the water. [It is certain, however, that those of Britain all leave the water at the end of summer, and have then a round tail. The small ones, even with the remnants of their gills still attached, may be

found in abundance at that period about the roots of rushes, &c., in the vicinity of ponds; whence it is not true that they quit in consequence of the water being dried up, as has been suggested].

The experiments of Spallanzani, on the extraordinary power which these animals have of reproducing their parts, have rendered them celebrated. They renew, many times successively, the same member after it had been severed; and this with all its bones, muscles, vessels, &c. Another faculty, not less singular, consists (as shown by Dufoy) in their recovering after having been long frozen up in ice. Their eggs are fecundated by fluid dispersed in the watery medium, which penetrates with the water into their oviducts. They lay long chaplets of eggs, and the young appear fifteen days from the deposition of them, retaining their gills for a longer or shorter period according to the species. Modern observers have distinguished several European species, the males of which develope high membranous dorsal crests very early in the spring, [which are absorbed, and the remnants cast off, ere they leave the water at the end of summer. One, with a smooth olive-coloured skin like a Frog (*T. punctatus*), and handsomely spotted with black, is common in stagnant waters throughout Britain; and two others (*T. palustris* and *T. marmoratus*), with a granulated skin like a Toad, and also spotted upon a much darker ground, and punctated with white, are—the first at least—equally so. All have the under parts bright orange colour. Those with granulated skins resemble the Toads in the capability of remaining without food for a most extraordinary period, in a state of imprisonment, having been found occasionally in closed cavities, where they must have remained for many years.]

The skeleton of an animal of this genus has been found among the schists of Œningen, which is three feet in length. It is the pretended fossil man of Scheuchzer.

In the suite of the Salamanders should range several very similar animals, some of which are reputed never to have gills, while others, on the contrary, retain them permanently, notwithstanding which they have the same lungs as the other Batrachians, being thus the only vertebrated animals that are truly amphibious.

The former of these, which have never been seen with gills, fall under two genera.

THE MENOPOMA, Harlan.

Form altogether that of a Salamander, the eyes apparent, feet well developed, and an orifice on each side of the neck. Besides a range of fine teeth surrounding the jaws, they have a parallel range before the palate. The known species, fifteen to eighteen inches in length, inhabits North America, where it is termed *Hell-bender*.

THE AMPHIUMA, Garden,—

Has also an orifice on each side of the neck, but the body is excessively elongated; the limbs and feet, on the contrary, but little developed; and the palatal teeth form two longitudinal ranges. Likewise from North America.

Among those which permanently retain their gills,

THE AXOLOTLS,—

Altogether resemble the tadpole of a Salamander. They have velvety teeth to both jaws, and two bands of the same upon the palate. From Mexico.

THE MENOBRANCHUS, Harlan,—

Has but four toes to each foot; a range of teeth on the intermaxillaries, and another parallel but more extended range, on the maxillaries.

THE PROTEUS, Laurenti.

Three toes before, and only two behind; the muzzle lengthened and depressed; both jaws furnished with teeth; tongue but slightly moveable, and free anteriorly; eyes excessively small, and couched beneath the skin, as in the mammiferous genus *Spalax;* ear covered by the flesh, as in the Salamanders; and skin smooth and whitish. The skeleton resembles that of the Salamander, except that it has many more vertebræ, and fewer rudiments of ribs; but the general conformation of the skull is very different. Inhabits the subterranean waters, with which certain lakes in Carniola communicate.

THE SYRENS (*Syren*, Lin.)—

Are elongated animals, having nearly the form of Eels, and three branchial crests; no hind feet, nor even vestige of pelvis; head flattened; mouth not deeply cleft; muzzle obtuse; eye very small; ear concealed; lower jaw armed with teeth all round, but none in the upper; and two raised series on each side of the palate.

One species (*S. lacertina*, Lin.) attains a length of three feet. Others are smaller, with the branchial crests less developed, and compose the *Pseudobranchus* of Gray.

THE FOURTH CLASS OF VERTEBRATED ANIMALS.

THE FISHES—(*PISCES*).

[Fishes are the proper vertebrated inhabitants of the waters; and they are formed and organized for living, moving, and in general finding their food, wholly within this element. The nature of their locality necessarily makes their history obscure, because human observation extends to only a very limited portion of the waters, and in that portion to only a trifling depth; but when we consider that, exclusive of lakes and rivers, the seas occupy full seven-tenths of the earth's surface, that those seas yield food as far down as the rays of the sun can extend their life-giving energy, and that there is no obstacle in the water to bar the motions of the fish, we can at once see that, of all vertebrated animals, they must be the most numerous, and probably they exceed in numbers the whole of the other three classes of the same grand division of animated nature. They inhabit, stratum super stratum, as it were,—one species near the surface, another near the bottom, and others, again, range through the intermediate depth. What may be the absolute depth of the ocean waters at which life ceases, and the profound of death and darkness begins, we have no direct means of ascertaining. It varies, of course, with the latitude, being greater as the rays of the sun are more direct, and less as their obliquity increases; and it probably also varies with the nature of the bottom. In correspondence with the vast range of pasture which is assigned to the Fishes, their productive powers are enormous,—the young produced by one Cod-fish, at a single deposit, being ascertained to be not much less than four millions, while in the common Flounder they are not fewer than one hundred and fifty thousand. A fertility so enormous, as compared with anything we are acquainted with on land, of itself shows the importance of the Class, and how well they are adapted for supplying each other with food. But, interesting as it is, the space to which we are restricted, forbids any disquisition on their physiology; and all that we can accomplish, is to render the text of the last edition of Cuvier's great work, as faithfully in substance, and as briefly in expression, as we possibly can. Our own original remarks must necessarily be few; and we shall inclose them in brackets, the same as this introductory paragraph, to distinguish them from the substantive part of the genuine text of Cuvier, which, in the way of systematic arrangement, has received no improvement, since the science of Zoology was deprived of that foremost of its cultivators.]

Fishes are oviparous Vertebrata, with a double circulation, and respiring through the medium of water. For this purpose they have, on each side of the neck, branchiæ, or gills, consisting of arches of bone attached to the *os hyoides*, or bone of the tongue; and to these arches the filaments of the gills are attached, generally in a row upon each, and having their surfaces covered by a tissue of innumerable blood-vessels. The water taken in by the mouth passes through among the filaments of the gills, and escapes by the gill-openings towards the rear. In its progress through the filaments of the gills, the water imparts to these the oxygen of the air which it contains [and receives carbon n return, the same as in the lungs of an air-breathing animal. The gills of a fish do not decompose water, so as to derive oxygen from it, but merely sepa-

rate the oxygen from the atmospheric air contained in the water; and hence, if water is deprived of this air, or impregnated with deleterious gases, Fishes cannot live in it. As little can they bear the return of water entering at the gill-openings, and escaping by the mouth; for if a fish is held so that the water is made to pass in this direction, it is as speedily drowned as if it were an air-breathing animal]. The blood is brought to the gills by the heart, which thus answers to the right ventricle of warm-blooded animals; and from the gills it is sent to an arterial trunk, lying immediately upon the under side of the back bone, which trunk is the left or systematic ventricle of the heart, and sends the blood throughout the body of the fish.

Living habitually in water, which is of very nearly the same specific gravity as their bodies, Fishes have no weight to bear, but merely to propel themselves through the water; and their form and their organs of motion are all adapted to this one purpose, though varying in the species. In many, there is under the spine a membranous air-bladder, which the fish can expand or contract at pleasure; and this is understood to alter its gravity, and enable it to suspend itself at any depth in the water. [Many fishes, wanting this apparatus, have, however, nearly the same habits as others which are possessed of it.]

Progressive motion is effected by the tail striking alternately right and left against the water, [for which purpose the flexure of the spine is lateral, whereas in the other Vertebrata generally, the principal flexure is vertical], and perhaps the jet of water thrown backward from the gill-openings may assist. Thus a fish has but little use for extremities; and the parts analogous to legs and arms are accordingly very short, terminating in a number of rays analogous to fingers and toes, and these, covered by membranes, form what are termed fins. The fins answering to arms are called *pectorals*, and those answering to legs *ventrals;* and besides these there are often fins on the back called *dorsal*, behind the vent called *anal*, and on the extremity of the tail called *caudal*.

The texture of the fins is important in classification. If the rays consist of single bones, whether stiff or flexible, they are said to be *spinous;* and if they consist of a number of jointed pieces, divided at their extremities, they are called *soft*, or *articulated*.

The pectorals are attached to two bones immediately behind the gills, and answering to the *scapulars*, which bones are sometimes imbedded in the muscles, or attached to the spine, but generally to the bones of the head. The *pelvis* rarely adheres to the spine; and it is often in advance of the belly, and attached to the bones of the shoulders.

The *vertebræ* have their proximate surfaces concave, and filled with cartilage, which forms the joints, and is generally continued by an aperture through the centre of each *vertebra*. Spinous processes, upwards and downwards, support the muscles, and maintain the vertical position of the body; but, as far as the cavity extends, the downward processes are wanting, and there are transverse processes, to which the ribs are sometimes soldered by cartilages.

The head varies much in form, but in general consists of the same number of bones as in the other Vertebrata,—a frontal of six pieces, parietals of three, occipitals of five, and five of sphenoid and two of each temporal bone, are included in the composition of the cranium.

Besides the brain, which is disposed as in Reptiles, Fishes have nodes or ganglions at the base of their olfactory nerves. The nostrils are simple cavities at the end of the muzzle, always pierced with two holes, and lined by a regularly-plaited pituitary mem-

brane. In their eyes, the cornea is flat, and there is a little aqueous humour, but the crystalline lens is almost spherical, and very hard. The ear is a sac, in which are suspended small hard bodies; and there are three membranous canals within the cranium in ordinary fishes, but in its walls in the cartilaginous ones. They want the Eustachian tube and tympanal bones; and only the Sharks and Rays have an external opening, which in them is level with the head. As great part of the tongue is bony, and as it is often furnished with teeth and other hard parts, Fishes can have little sense of taste. The fleshy *cirri*, or beards as they are termed, of some of the species, are perhaps organs of touch. The body is in general covered with scales, and generally speaking they have no organ of prehension except the mouth.

In most fishes, the intermaxillary bone forms the edge of the upper jaw, having the maxillary or the labial behind it. The palatal bones, pterogoid and zygomatic processes, and the tympanum and squamosa, form an anterior jaw, as in Birds and Serpents, to the posterior part of which the lower jaw is articulated, which jaw has generally two bones in each side, except in the cartilaginous fishes. The teeth are very various in situation, in number, and in form. They are found on the intermaxillaries, the maxillaries, the lower jaw, the vomer, the palate, the tongue, the gill-arches, and even on the bones of the pharynx behind these; [but many fishes have them only on some of these places, and there are some which are almost, if not altogether, toothless].

Besides the gill-arches, the hyoid bone supports the gill-membrane. The *gill-lids*, or *operculi* [by the working of which respiration is carried on], consist of three pieces, the operculum, sub-operculum, and inter-operculum. These are articulated on the temporal bone, and play on the pre-operculum; but many of the cartilaginous species want them.

The stomach and intestines differ greatly; and, except in cartilaginous fishes, the pancreas is supplied by cœca round the pylorus, or by a duplicature of the intestine. The kidneys are against the spine, but the bladder is above the rectum, and opens behind the vent and the reproductive passage, contrary to what is found in the Mammalia. The male organs are large glands termed *milts*, and the female are sacs, which also attain great size, and have the eggs in their internal folds. In most fishes, there is no impregnation till after the expulsion of the eggs; but in the Sharks and Rays, and some others, the case is different, some of them producing perfect eggs, and others bringing forth the young alive.

The proper classification of Fishes is a very difficult matter. There are two distinct series of them:—FISHES, properly so called, or *Bony Fishes;* and *Cartilaginous Fishes*, or CHONDROPTERYGII. The latter want some bones of the jaws, and have other peculiarities: they are divided into three orders;—

CYCLOSTOMI (round-mouths, or suckers), which have the jaws soldered into a sort of ring, and numerous gill-openings.

SELACHII (Sharks and Rays), which have gill-openings similar to the former, but the jaws not soldered into a ring.

STURIONES (Sturgeons), which have the gill-openings with a lid, as in the Fishes properly so called.

Of the ORDINARY FISHES, or those with bones in the skeleton, one order have the maxillary bone and the palatal arch fixed to the cranium. These are called PLECTOGNATHI (soldered jaws), and they consist of two families: *Gymnodontes* (naked teeth), and *Sclerodermi* (hard skins). Another order, the LOPHOBRANCHII, which consists

but of one family; and which, with the jaws perfect, have the filaments of the gills arranged in tufts upon the arches.

In the rest, which include by much the greater number of the True Fishes, the character employed by Ray and Artedi, and taken from the nature of the first rays of the dorsal and anal fins, furnishes two principal divisions. These are MALACOPTERYGII (soft fins), in which all the rays, with the occasional exception of the first dorsal or the pectorals, are soft or jointed; and ACANTHOPTERYGII (spiny fins), in which the first portion of the dorsal, or first dorsal when there are two, always have spinous rays, and which have also some in the anal, and at least one in each ventral.

The first of these sub-classes may be divided according to the position of the ventral fins. If these are on the belly, the fishes are *Abdominal;* if attached to the shoulder, they are *Sub-brachian;* and if wanting, they are *Apodal.* Each of these orders comprises certain families, of which the abdominal ones are very numerous.

The Spinous Fishes do not admit of this kind of division; but must be separated into families, the characters of which are, in many instances, well defined. The same gradation of families cannot be traced among Fishes as among Mammalia. Thus, the organs of sense, and those of generation in some, indicate connexion between Cartilaginous Fishes and Serpents, while the imperfect skeleton of others of these fishes indicates a relation to Mollusca and Worms, [though the far more important disposition of the nervous system, characteristic of the type of Vertebrated Animals, is still retained.

The abstract of Cuvier's arrangement of Fishes, by far the best—that is, the most natural, which has hitherto been made, or which there are materials for making—may be given briefly thus:—The series of True or Bony Fishes he divides into the two divisions already mentioned, as distinguished by the rays of the fins. The Spinous Fishes form a single order, and this order he divides into fifteen families, which he names, from some well-known species as the type, or for some marked peculiarity of character which belongs to the whole of the family and to no other fish. The Soft-finned Fishes he divides into three orders, according as the ventral fins are abdominal, thoracic, or wanting; and the Cartilaginous Fishes he divides into two orders,—those with free gills, and those with the gills fixed.]

THE FIRST ORDER OF BONY FISHES.

ACANTHOPTERYGII.

This first order contains by far the greater number of the Ordinary Fishes. Their characters are spinous rays in the first dorsal, if there are more than one, and spinous rays in the first part if there is one only; but sometimes, instead of a first dorsal, they have free spines without any connecting membranes. The anal fin has also its first rays spinous; and there is generally one such ray in each ventral. [When we speak of the first ray of a fin, we mean the one nearest the head of the fish, which is easily understood in the other fins, and is the extreme one either above or below in the caudal.]

The spinous fishes are arranged into fifteen families, and some of these families contain a vast number of genera. The families are named, as already noticed, from some well-known species, or some strikingly peculiar character. [When a species is the type, the technical name of the family ends in *idæ* or *oidæ*, the Greek word for resemblance; and when it is founded on a peculiar character, the name is descriptive of that].

THE FIRST FAMILY OF THE ACANTHOPTERYGII.

PERCIDÆ (the PERCH Family).

These fishes have the body oblong, covered with hard or rough scales, with the gill-lid or gill-flap, or often both, toothed or spinous in the margins. The species are very numerous in the waters of all warm countries; their flesh is in general agreeable and wholesome; they are mostly *thoracic*, or have the ventral fins under the pectoral, and they are subdivided according to the number of gill rays. The first division have seven rays in the gills, two dorsal fins, and all their teeth are *velvety*. [Cuvier makes use of this expression as descriptive of very minute teeth, set closely together in numerous rows, and thus resembling the pile of velvet in arrangement though not in texture.]

This division comprises various species, of which the following are the principal genera:—

Perca, including the Common Perch of Europe, and various other species of North America and other places *Labrax*, the *Basse*, a marine genus, of which species are found both in Europe and in America; *Lates*, the Perch of the Nile, of which there are also species in the Indian rivers; *Centropomus*, the Sea Pike, which has the operculum obtuse and without spines; *Grammistis*, an Indian genus, with white longitudinal stripes, and a black ground; *Arpro*, the River Perch, found chiefly in the Rhine; *Zingel*, a peculiar Perch of the Danube, with thirteen spines in the first dorsal.

This subdivision also comprehends some fishes of foreign countries, whose peculiarities cause several subgenera. These are, *Huro*, like a true Perch, only the pre-operculum is not toothed; *Etelis*, with hooked teeth in the jaws, but not in the palate; *Niphon*, with strong spines on the pre-operculum and operculum; *Enoplosus*, like a Perch, but with body much compressed, two high dorsals, and the pre-operculum deeply toothed; *Diplorion*, compressed, double-toothed border to the pre-operculum, and two spines on the gill-lid. Other species of this subdivision are, *Apogon*, small fishes, of a red colour, with two dorsals far apart, and large scales, easily separated. One of them, the King of the Mullets, or Beardless Mullet, is found in the Mediterranean; *Cheilodipterus*, resembling the former, but with long teeth in the jaws; and *Pomatomus*, a very rare genus, of small size, with immense eyes, and exceedingly small teeth, velvety in their arrangement.

A second subdivision have two dorsal fins, but long and pointed teeth, mingled with a velvety arrangement.

Of these the principal genera are *Ambassis*, with the dorsals near each other, and a spine in front of the former; they are small fishes of the warm regions of the East, abundant in pools and rivulets, and sometimes prepared as Anchovies; and *Lucio-perca*, the Perch-Pike, with long teeth on the maxillaries, and and also in the palate, found in Eastern Europe.

The second division of the Perches have seven rays in the gills, but only one dorsal fin; the genera are arranged by the characters of their teeth, and the leading ones are these:—

Serranus, the Sea Perch; *Anthias*, the Barber, a beautiful red fish of the Mediterranean, with metallic reflections; *Merous*, the Great Perch, and some varieties.

Distinct from these are several genera, *Plectrepoma*, *Diacopus*, *Mesoprion*, *Acerina*, *Rypticus*, *Polyprion*, *Centropristis*, and *Gristes*. These inhabit different parts of the world, and some of them are beautiful fishes.

The Percidæ with less than seven gill-rays, are arranged according to the number of their dorsal fins and the characters of their teeth.

With a single dorsal, some have hooked teeth among the other ones, as *Cirrhites*, which inhabit the Indian Ocean, and have six gill-rays. Others have only small teeth, among which there are the following genera, *Chironemus*, *Pomotis*, *Centrachus*, *Priarcanthus*, *Dules*, *Therapon*, *Palates*, and *Elotes*. These are chiefly fishes of the warm countries, some of the fresh water and others of the sea; their colour is in general silvery, marked with blackish longitudinal lines.

There are two genera of Percidæ which have less than six gill-rays and two dorsals.

These genera are *Trichodon*, a native of the North Pacific; and *Sillago*, found in the Indian Ocean. One of the latter is supposed to be the finest fish in India.

We now pass on to other Percidæ, which have more than seven gill-rays, and seven soft rays besides a spine in their ventrals, the other *Acanthopterygii* having never more than five soft rays.

The genera, *Holocentrum*, *Myripristis*, *Beryx*, and *Trachichthys*, all of which are brilliant fishes of the warm seas, and some have the air-vessel divided into two parts.

All the Percidæ hitherto mentioned have the ventrals immediately under the pectorals; but there are others which have them differently placed.

The *Jugular* Percidæ have the ventrals upon the throat farther forward than the pectorals. They comprehend the following genera:—

Trachinus, the Weevers, with the head compressed. the eyes near each other, the mouth obliquely up-

wards, the first dorsal very short, but with a formidable spine on the first ray, the second dorsal long, the pectorals large, and a strong spine on the operculum. These fishes lie in the mud, and inflict severe wounds with their dorsal spine, which the fishermen believe has a poisonous quality, but it is merely rugged, and lacerates an ill-conditioned wound, similar to what is inflicted by the antler of a Stag. *Percis*, which resemble the Weevers, and inhabit the warm seas, have crooked teeth on the maxillaries and the vomer, but none on the palatal bones. *Pinguipes*, also of the warm seas, more sluggish than the preceding genus, with the teeth strong and conical, fleshy lips, and teeth on the palate. *Percophis*, with the body very long, some of their teeth long and pointed, and the lower jaw much advanced.

One very remarkable genus of Percidæ is *Uranoscopus*, the Star-gazer, so called because the eyes are placed on the upper surface of the nearly cubical head, and directed toward the heavens. Their-pre-operculum is toothed on the lower part; their mouth is cleft vertically; they have a strong spine on each shoulder, and only six rays on each gill. Within their mouth, behind the tongue, is a narrow slip which they can protrude, and with which they attract small fishes, while themselves are concealed in the mud. Their gall bladder is of immense size. One species, *U. scaber*, inhabits the Mediterranean, but none of the others are European. This is a very ugly fish, but still it is eaten.

The third division comprises the *Abdominal* Percidæ, or those which have the ventral fins behind the pectorals.

One genus has them still partially attached to the bones of the shoulder. This is *Polynemus* (many fillets), so called because the inferior rays of their pectorals are filled and extended into long threads. Their teeth are in part velvety, like those of the true Perches, and partly also like those of a Carp, and they have them on the maxillaries, the vomer, and the palate. Their snout, however, is rounded, and the vertical fins are scaly. They are found in the waters of warm countries, and one, *P. paradiseus*, of a beautiful yellow colour, with seven filaments from the fin on each side, at least twice as long as the body, is the celebrated "mango fish" of the Ganges, reckoned the most delicious in India. Most of the other species have the filaments shorter, but the flesh of all of them is excellent.

The following genera have the ventrals still farther behind, and the bones of the pelvis quite detached from the bones of the shoulder. Of these there are several:—

Sphyræna, the Sea Pike, which has been confounded with the *Esox* or True Pike. They are large fishes, with an oblong head and projecting under jaw. There are several species inhabiting the warmer seas, and one, *S. barracuda*, is as much dreaded as the White Shark. *Paralepis*, small fishes, resembling the last genus in general characters, but with the second dorsal fin small and fleshy. *Mullus*, the Sur-mullet, a very celebrated genus, and held in much estimation by epicures. These fishes must not be confounded with the Mullets properly so called, which give name to another family, and are typical of it, being very different in form and appearance from the Surmullets. The latter have the body thick and oblong, with the profile of the head nearly vertical, the eyes far up, teeth in the lower jaw and palate only, two cirri inwards at the lower jaw, and but four rays in the gills. There are two species, both of which are European, the Striped Red Mullet, *M. surmulatus*, which is not very uncommon on the southern coast of England; and the Plain Red Mullet, *M. barbatus*, which, though named as a British fish, is chiefly found in the Mediterranean. Both species are delicious eating; and the luxurious Romans used to feast their eyes with the changes of colour in the Red Mullet when dying, before they devoured its flesh. *Upeneus* is a genus of the tropical seas, with teeth in both jaws, but none in the palate. They have only four gill-rays, like the Surmullets, but have also an air-bladder, which the latter are without. These complete the family of the *Percidæ*, as now known.

THE SECOND FAMILY OF ACANTHOPTERYGII.

FISHES WITH HARD CHEEKS.

This family comprehends a number of fishes of which the appearance of the head is singular, being variously mailed, or defended by spines and scaly plates of hard matter; but they have many characters in common with the *Percidæ*. Their principal distinction consists in the suborbital bone being more or less extended over the cheek, and articulated with the operculum. The Star-gazer is the only genus of the Perch family which resembles them in this respect; but in it, though the suborbital bone is very broad, it is connected posteriorly with the temporal bones, and not with the operculum.

The following are the principal genera:—

Trigla, the Gurnards, so called from the sounds which they utter with their gill-lids when taken out of the water. They have an immense suborbital plate, to which the operculum or gill-lid is articulated by an immoveable suture, so as to be incapable of separate motion. They have the head vertical in the sides, hard and rough bones, two distinct dorsals, three free rays under the pectorals, twelve cœca, and an air-bladder of two lobes. The Gurnards properly so called, have small teeth in both jaws, and in front of the vomer, together with large pectorals, but not sufficiently so for raising them out of the water, like those of the Flying Fishes. There are many species found in the temperate seas, which, though in estimation for the table, are inferior in this respect to the Sur mullets. The English species are *T. cuculus*, the Red Gurnard, with strong plates in the cheeks, the body

lengthened, and nearly round, one spinous and one soft-ray dorsal fin; seven rays in the gills, gill-opening large, and with three free rays at the base of each pectoral. *T. Hirundo*, the Sapphirine Gurnard, with the pectorals of immense size, but in most of its other characters analogous to the Red Gurnard. It is more abundant than that species, and grows to a larger size. Is rather a dry fish, but the flavour is tolerably good, and it answers very well for salting. There are various other species, chiefly found in the Mediterranean.

The following genera, which are closely allied to the Gurnards, deserve some notice:—*Prionotus*, an American fish, resembling the Sapphirine Gurnard, but with the pectorals so large, that they can support the body during a considerable leap through the air. They have a characteristic band of small teeth, closely crowded together, upon each parietal bone. *Peristidion*, a genus having the whole body mailed with large hexagonal scales, ranged in longitudinal rows. Their muzzle is divided in two, and there are cirri to the mouth, but no teeth. *Dactylopterus*, celebrated as Flying Fishes. They have the subpectoral rays numerous, longer than the body, and united by a membrane, so as to furnish large supplemental fins, by means of which the fishes can protract their fall for a few minutes, when they spring from the water to escape the Coryphenes, and other enemies; but as the fishes cannot fly, or take a new impulse from the air, they speedily fall down and become the victims of the pursuers. They are found in the Mediterranean and Indian Ocean; and are small fishes, seldom more than a foot in length. *Cephalacanthus*, resembles the former, with the exception of the supplementary fins, or wings, as they are sometimes improperly called. *Cottus*, the *Bull-head*, of which there are several species. They have the head depressed, with teeth in both jaws and in the front of the vomer, the gill-lids furnished with spines; gills with six rays, and large openings, bodies slender, and without scales; two dorsals, near to each other, and the ventral fins small. Of these, *C. gobio*, the Miller's Thumb, is found in rivers; *C. bubalis*, which has the gill-lids very spiny, *C. quadricornis*, with four short spinous processes on the top of the head, are found in the sea: besides these there are some foreign species.

Apidophorus, the Pogge, sometimes termed the Armed Bull-head, has the body octangular, and covered with scaly plates, with recurved spines on the snout, and teeth in the jaws only; it is a genus found in the Northern Atlantic and Pacific, but the species are small and unimportant.

Some groups, recently known, have the characters of *Cottus*, and of *Scorpæna*. Of these we may notice *Hemitripterus*, with two dorsals, a bristly head, and no scales on the body; it varies in length from one to two feet, and is found on the American shores. *Hemilepidotus*, has only one dorsal; teeth in the palate, and longitudinal bands of scales, which are not visible till the body is dried; it occurs in the Pacific. *Platycephalus*, is found in the Indian Ocean. It has large ventrals, with six rays placed behind the pectorals; the head depressed, and sharp and spinous at the sides, but not operculated. There are seven rays in the gills, a row of sharp teeth in the palate, and the body covered with scales.

Scorpæna, of which there are two subgenera, which have the head rough, and hardened with plates, and are compressed laterally; the body is scaly; and there is one dorsal fin. Except in the singular appearance of their armed and tuberculated heads, they very much resemble the Perches. The subgenera are *Scorpæna*, without scales, but armed with spines, which are accounted dangerous. They are a gregarious fish, and have their haunts among the rocks. Some allied species have the body much compressed, and a very high dorsal fin, united to the caudal. *Sebastes*, the Norway Haddock, rather a large species, with many spines on the head, a long dorsal, of which the posterior portion has soft rays; the eyes very large, and teeth in all the jaws. It inhabits the northern seas, and the Greenlanders use its spines as needles. *Pterois*, Indian fishes, resembling the last genus, but with no lateral and pectoral rays; remarkably long; their colour very beautiful; and no teeth in the palate. *Blepsias*, inhabits the North Pacific; has hard cheeks, cirri on the lower jaw, five gill-rays, small ventrals, and one dorsal, consisting of three lobes. *Apistes*, Treacherous, are small fishes, having a formidable spine on the suborbital plate, and branched rays in the pectorals. Some have scales, and some not. *Agriopus*, want the spine of the former, have the dorsal very high, and reaching to between the eyes, a narrow muzzle, and the body without scales. *Pelor*, like Scorpæna in their teeth; two free rays in the pectorals, head flat, eyes close together, dorsal spines very high, and whole appearance singular. *Synanceia*, as ugly as the former; the head shapeless, tuberculated, and the skin loose. No teeth on the vomer or palate. Like most of the analogous genera, they inhabit the warm seas, and this genus is considered poisonous. *Monocentris*,—body short, thick, completely covered with rough, angular plates, four or five stout spines in place of the first dorsal; each ventral a single large spine; head and mouth large; teeth on the jaws and palate, short and crowded; found near Japan. *Gasterosteus*, Stickleback, a numerous and very common genus, found both in fresh waters and the sea. Named from the free spines on the back, and a bony covering on the belly. Their ventrals, placed behind the pectorals, consist only of a single spine, and they have but three rays and gills. There are several European species, distinguished chiefly by the number and character of their spines. Though of small size, they are exceedingly voracious. *Oreosoma*, a small oval fish, with its body all covered over with scaly cones; only one species is known.

THE THIRD FAMILY OF THE ACANTHOPTERYGII.

SCIÆNIDÆ (the MAIGRE Family).

These still resemble the Perches in the notches of the pre-operculum and operculum; but they have no teeth on the vomer or palate. The muzzle is thickened, and there are a few scales on the dorsal fins, of which fins some genera have one and others two.

The following are the principal genera:—

Sciæna, of which there are seven subgenera. The general characters are,—the head inflated, and supported by cavernous bones; two dorsals, or one deeply notched, the soft part much longer than the spinous; the anal short, the pre-operculum toothed, and the operculum divided into points at its extremity; seven arches in the gills. They resemble the Perches, only they have no teeth in the palate; their whole head is scaly, their air-bladder often curiously fringed, and the stony appendages in the ear larger than in most fishes. The following are the subgenera :—

Sciæna, or Maigres, properly so called, which have the spines of the anal weak, and neither elongated canine teeth nor cirri at the mouth. One species, *S. umbra*, inhabits the Mediterranean, and used to be highly esteemed, but has latterly become rare. It grows to the length of six feet or more. Some other species of this subgenus are found in the Southern and Indian Seas.

Otolithus, has the anal spines weak, and no cirri, some elongated or canine teeth, and two horns attached to the air-bladder, and erected forwards. They are Indian and American fishes; one is known as the Stone Perch of Pondicherry. *Ancylodon*, resembles the former, but has a short muzzle, long canine teeth, and a pointed tail. *Corvina*, small and crowded teeth, with neither canines nor cirri; the second anal spine rather strong. One, species, *C. nigra*, is abundant in the Mediterranean, and there are others in the Indian and American seas. *Johnius*, resembles the last, but has the second anal spine weaker, and shorter than the soft rays. They are found in the seas of India, Tropical Africa, and America, and are esteemed as food, their flesh being white and easy of digestion. *Umbrina*, distinguished by a cirrus on the lower jaw. A remarkably beautiful fish, found plentifully in the Mediterranean, and occasionally on the southern coasts of Britain. Its ground colour is golden, with bright bands of steel blue; and its flesh is excellent. It is not a very long fish, but is sometimes forty pounds in weight. *Pogonias*, somewhat like the former, but with several cirri below the jaw. Some of them are silvery, and attain the size of an Umbrina. This fish produces much more sound than any of the other Sciænidæ, on which account it is sometimes called the Drum-fish.

Eques, has a long and compressed body, elevated at the shoulders, and tapering to the tail; the teeth are small and closely set; the first dorsal is high, the second long and scaly; and they all belong to the American seas.

The Sciænidæ with a single dorsal fin, are subdivided according to the number of the gill-rays. Those which have seven, correspond to some genera of the Sparidæ, and have the pre-operculum always notched. The following genera have seven gill-rays :—

Hæmulon, has the muzzle lengthened, resembling that of a Hog; the lower jaw compressed, opening very wide and of a bright red. Hence they are called "Red-throats" in the West Indian Islands. Their teeth are small, and closely set; and their dorsal fin is slightly notched, having the soft part scaly. They inhabit the American seas.

Pristipoma, have pores in the jaw, like the last species, but the muzzle thicker, the mouth not so deeply cleft, and their dorsal and anal fins without scales. The obtuse angle of the operculum is concealed by a membrane. They are numerous, and inhabit the warm latitudes of both oceans.

Digramma, resemble the last-named, except that the cavity of the symphysis is wanting, and there are two large pores beneath each side. They are found in both oceans. Those of the Atlantic have large scales, and those of the Indian Ocean smaller, and a shorter and thicker muzzle.

The Sciænidæ with a single dorsal, and less than seven gill-rays, admit of more subdivision. Some have the lateral line extending to the caudal fin, others have it interrupted. The following genera possess the former character :—

Lobotes, have the muzzle short, the lower jaw prominent, the body high, and the posterior angle of the dorsal and anal fins so elongated, as, with the rounded caudal fin, to appear in three lobes. There are four groups of very small points near the end of the jaw. They inhabit both oceans.

Cheilodactylis, have the body long, the mouth small, many spinous rays in the dorsal, and the lower rays of the pectorals simple, and produced beyond the membrane.

Scolopsides, have the second suborbital plate toothed, and terminated by a point directed backwards, crossing another point of the third suborbital, directed the contrary way. The body is oblong, mouth little cleft, teeth velvety, scales large, and no pores in the jaws. They inhabit the Indian seas.

Micropteres, have the body oblong, three spines on each side of the jaw, and the last rays of the soft part of the dorsal separated from the others, and forming a small peculiar fin. They have the operculum without notches.

The Sciænidæ with less than seven gill-rays, and the lateral line interrupted, form several genera of small oval fishes, generally finely coloured, and distinguished by the armature of their heads. They have a nearer relation to the genus Chætodon, and resemble some of the fishes with labyrinthic branchiæ. The following are the genera :—

Amphitrion, with the pre-operculum and three operculum pieces dentelated, the latter produced on a single row of blunt teeth. *Pomacentres*, have the pre-operculum dentelated, the operculum without armature, and a single row of trenchant teeth. *Premnas*, have one or two stout spines on the suborbital, and the pre-operculum toothed. *Dascyllus*, resemble Pomacentres, except in having the teeth very small, and thickly crowded. All the genera inhabit the Indian seas.

Glyphisodon, with the gill-lids entire, and a single row of trenchant and generally notched teeth. They are found in the Atlantic, but more abundantly in the Indian seas.

Helianus, resemble the preceding genus in their operculum, but have the teeth small and velvety.

THE FOURTH FAMILY OF THE ACANTHOPTERYGII.

SPARIDÆ (the SEA-BREAM Family).

These have no teeth in the palate; their general figure resembles that of the preceding family; their bodies have scales larger or smaller, but they have none on the fins; their muzzle is not thickened, nor the bones of the head cavernous; they have no notches in their preoperculum, nor spines on the operculum; their pyrolus has cœcal appendages; they have six gill-rays, which are arranged according to the form of the teeth. The first tribe, of which there are five genera, have the sides of the jaws set with round, flat teeth, resembling a pavement. The genera are as follow:—

Sargus, with cutting teeth in the front, like those of Man; but in some species the teeth vary.

Chrysophris, Gilt-heads, with round grinders in the sides of the jaw, and a few blunt conical teeth in front. There are two European species: *C. auratus*, a large and beautiful fish, with a golden eyebrow; and *C. microdon*, with the teeth smaller, and the profile fuller. The first species is occasionally found on the south coast of England. They have very strong teeth, and are able to break the hardest shells of the Mollusca.

Pagrus, has only two rows of grinders.

P. vulgaris, silvery, glossed with red, inhabits the Mediterranean, and is occasionally met with on the English shores. There are others in the Atlantic and the Indian Ocean, and one of Southern Africa, which has the jaws as hard as stone.

Pagelus, has the teeth smaller, and the muzzle more elongated. *P. erythrinus*, the Spanish Bream, is silvery, glossed with rose-colour: it is a very beautiful fish. There are numerous others found in the Mediterranean and other seas; but the species named is the only one that occurs on the English coast, excepting the Sea Bream, *P. centrodentus*, which is of the same colour as the former, but has a large dark patch on the shoulder.

Dentex, has all the teeth conical, and the front ones hooked. One species, *D. vulgaris*, occasionally occurs in the south of England, and there are various others.

Some have the mouth less cleft, the body lower, and the caudal scaly to the end; and others have no scales on the cheek, but a pointed scale between the ventrals, and one above each of them. These form a second tribe of the family; and a third tribe also consists of a single genus,—

Cantharus, which has crowded teeth, hooked, and placed cardwise round the jaws. One species, *C. griseus*, of a silvery grey colour, with brown longitudinal stripes, is found on the English shores, and known as the Black Bream.

The fourth and last tribe consists of two genera:—

Boops, with the mouth small, and the external teeth trenchant. There are several species in the Mediterranean, silvery or steel-coloured, with longitudinal golden stripes. *Oblada*, with small crowded teeth behind the trenchant ones; silvery, with blackish stripes, and a broad black spot on each side of the tail.

THE FIFTH FAMILY OF THE ACANTHOPTERYGII.

MENIDÆ.

These differ from the last in the great extensibility of the upper jaw, which is advanced or withdrawn by means of long intermaxillary pedicles. It contains only the following four genera:—

Mæna, with fine narrow teeth in the jaws, and a band of the same on the vomer; body shaped like that of a Herring, lead-coloured on the back, silvery on the belly. *Smaris*, want the teeth on the vomer, and the body is less elevated. *Cæsio*, has the dorsal somewhat higher. *Geres*, mouth protractile, jaw descends in advancing, and teeth in the jaws only: much esteemed for food. The first two genera inhabit the Mediterranean, the third the Indian Ocean, and the fourth the Atlantic, whence a stray individual sometimes reaches the coast of England.

THE SIXTH FAMILY OF THE ACANTHOPTERYGII.

SQUAMIPENNES (Scaly-finned).

These fishes are so designated because the soft, and often the spinous parts, of their dorsal fins are so covered with scales as not to be easily distinguished from the rest of their bodies. This is the most distinguishing character; but they also have, in general, the body much compressed, and the intestines long, and with numerous cœca. Linnæus included all those known in his time in the genus *Chætodon*, or bristle-teeth, from the thinness and close array of these parts; but this genus admits of subdivision, and there are some others.

The *Chætodons* have their teeth like a brush, their mouth small, their dorsal and anal fins scaly like the body, so that it is difficult to say where the fin commences. They abound in the seas of warm

climates, and are remarkable for the beauty of their colours. Their intestines are long, with numerous cœca, and their air-bladders are large and strong. They frequent rocky shores, and are eaten. The following are the genera :—

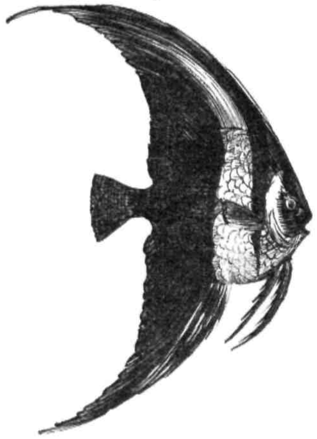

Fig. 183.—Chætodon rostratus

Chætodon, properly so called, with the body more or less elliptical, the spinous and soft rays continued in a uniform curve, the snout projecting more or less, and sometimes a small dentation on the operculum. They all resemble each other, even in their colours, being marked with a black band which passes over the eye. In some, there are several vertical bands; others have them longitudinal, or oblique; some have brown spots on the flanks; some have glossed bands on the vertical fins, and one or two ocellated spots. Some of them are also distinguished by filaments produced from the soft rays of the dorsal, and others have very few spines in that fin.

Chelmon, remarkable for the length of its snout, with the mouth small, and at the extremity, and the teeth fine like hairs. One species, *C. rostratus*, has the faculty of shooting insects with drops of water projected from the mouth, and it seizes them as they fall. It is found near the shores of South-eastern Asia.

Heniochus, Coachman, have the first spines of the dorsal, and particularly the third and fourth, extended into filaments like a whip, and often twice the length of the body.

Ephippus, Horseman, with a deep notch between the spinous and soft portions of the dorsal, the first of which has no scales, and can be folded into a groove on the back. There are various species, some of the American and some of the Indian seas; and one species is said to be a very foul feeder. Many of this genus are found fossil in Mount Bolca in Italy, which is a vast magazine of petrified fishes.

Holocanthus, have a strong spine on the operculum, with the edge of that toothed. They are found in the warm latitudes of both oceans. Their flesh is excellent, and the colours beautiful, and regularly marked.

Pomacanthus, have the body more elevated from a sudden rise of the edge of the dorsal. They are only known as American.

Platax, has trenchant teeth, with three points in front of their brush-like ones, and their body strongly compressed, and continued into thick, elevated, and scaly fins, with a few concealed spines in the anterior edge, so that the height is much greater than the length. They inhabit the Indian Ocean, but a fossil species has been found at Bulca.

Psettus, resembles Platax, but has all the teeth small and crowded; and the ventrals, which are very long in that, reduced to a small spine, without soft rays. They are of various forms, and known only as inhabitants of the Indian Ocean.

Pimelepterus, with a single row of teeth placed on a horizontal base or heel, and trenchant in the anterior part. The body is oblong, the head blunt, and the fins thickened with scales, whence the name. They inhabit both oceans.

Diptærodon, an analogous genus, with trenchant teeth, chisel-shaped, and the spinous and soft parts of the dorsal separated by a deep notch. Found in the Southern Ocean.

The following genera, which are ranged with Chætodon, on account of their scaly fins, yet differ from them in having teeth on the vomer and palate :—

Brama, Ray's Bream, has the body deep and compressed, the profile almost vertical, one elongated dorsal fin, scales on the dorsal and anal, and slender curved teeth on the jaws and bones of the palate. It is found in the warmer seas, but is occasionally met with on the shores of England.

Pempheris, has a long and scaly anal, the dorsal short and elevated, and an obtuse profile and large eye; a small spine on the gill-lid, and small crowded teeth on the jaws, vomer, and palate. Inhabits the Indian seas.

Toxotes, the Archer, has the body short and compressed, the dorsal far backwards, the snout short and depressed, and the lower jaw projecting beyond the upper one. It has small teeth crowded in all parts of the mouth, and the gill-lids finely toothed. It hits insects with drops of water at the height of three or four feet above the surface, and is remarkably sure of its aim.

THE SEVENTH FAMILY OF THE ACANTHOPTERYGII.

SCOMBERIDÆ (the MACKEREL Family)

This family comprises a vast number of genera, many species, and countless individuals. They are eminently useful to Man, and are the object of some of the most extensive fisheries. Many of them were included by Linnæus in one genus, *Scomber*, but they are subdivided as follows :—

Scomber, the Mackerel, with the body spindle-shaped, beautifully coloured, smooth, and with small scales. The common Mackerel is well known as one of the most valuable of the fast-swimming surface

fishes, for the rapidity with which it dies when out of the water, and also becomes putrid, or tainted. There are several species in the European and American seas.

Thynnus, the Tunny, has a soft corselet of large scales on the thorax, a cartilaginous keel between the crests and the sides of the tail, and the first dorsal approaching the second. It is very abundant in the Mediterranean, where it sometimes attains the length of fifteen or eighteen feet. It is captured in vast numbers, and forms an essential article of the food of the people. It has been known in the Mediterranean from the remotest antiquity, and occasionally appears on the British coast. There are several species, of which the Bonito, or Striped Tunny, is one of the most striking.

Orcynus, has the pectoral fins much longer than the Tunny, the back blackish, the belly silvery, and the flesh much whiter than that of the Tunny. In summer, it visits the Mediterranean and Bay of Biscay, in shoals. [Most of the Scomberidæ frequent the shores in summer, for the purpose of depositing their spawn; and they subsist, in great part, upon the fry of the later spawners, as these again live upon theirs, which is a beautiful adaptation, whereby the immense surplus of one family of fish adequately supplies the wants of another.]

Auxis, have the corslet and short pectorals of the Tunny, and the separate dorsals of the Mackerel. Found in the Mediterranean. Of a fine blue on the back, with oblique blackish lines, and the flesh deep red. A West Indian species equals the Tunny in size.

Sarda, differ from the Tunnies in having the teeth separate, strong, and pointed. The only known species inhabits both oceans, and is common in the Black Sea and Mediterranean.

Cybium, have the body long, no corselet, jaw-teeth large and lancet-shaped, parietal teeth small, short, and crowded. Found in the warm parts of both oceans; and some of the species grow very large. *Thyrsites*, has the front teeth longer than the others, pointed teeth on the palate, and no lateral keels to the tail.

Gempylus, have jaw-teeth similar to the last, but no parietal teeth, and the ventral fins scarcely perceptible.

[These are the subgenera of Scomber, and the remaining Scomberidæ have characters somewhat different.]

Xiphias, the Sword-fishes, resemble the Tunnies in their very minute scales, the keels in their tails, the power of their caudal fin, and their whole internal organization. Their distinguishing characteristic is a long pointed beak, formed like a sword or spit, which terminates their upper jaw, and is a most powerful offensive weapon, with which they attack the largest animals in the ocean, [and sometimes drive it into the timbers of ships, where it breaks, and a portion is left]. This beak is principally composed of the vomer and the intermaxillaries, and supported at its base by the ethmoid and the frontal maxillaries. Their gills are not divided like the teeth of a comb, but each consists of two large and parallel laminæ, with reticulated surfaces. They swim with extreme rapidity, [and it is probable that the peculiar gills enable them to do this with safety, not being liable to get entangled like those in threads]. Their flesh is excellent. The subgenera are,—

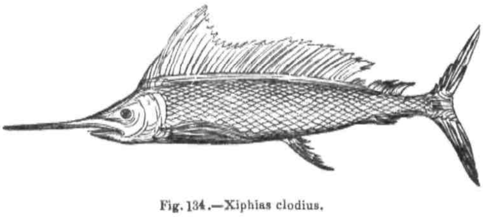
Fig. 134.—Xiphias clodius.

Xiphias, the Sword-fish, properly so called; has the beak long, flattened horizontally, and trenchant, like the blade of a large sword; sides of the tail with strong keels; only one dorsal, which wears in the middle in old specimens, and then seems two. This is one of the largest and best fishes in the European seas, and is frequently fifteen feet long. It is very abundant in the Mediterranean, but less so in the Atlantic. Notwithstanding its formidable weapon, its great strength, and its almost incredible celerity, a small crustaceous animal penetrates the flesh of the Sword-fish, and sometimes so torments it that it dashes itself on the shore with mortal violence.

Tetrapturus. Beak shaped like a stiletto; each ventral consists of one jointless blade; two small crests on each side of the base of the caudal, as in the Mackerel. [These lateral crests on the tail appear to steady that powerful organ, and thus render it more efficient and unerring in its intense labour.] One species inhabits the Mediterranean.

Makaira, like the former, but wants the ventral plates; rather a doubtful species.

Istiophorus, has the beak and caudal crests like Tetrapturus, but the dorsal high, and serving as a sail in swimming; and the long and slender ventrals are composed of two rays each. Several species have been named, but they are imperfectly known. All the Sword-fishes attain a large size, [and the dorsal fin is subject to variations].

Centronotus, a genus having free spines instead of the first part of the dorsal, and ventrals in all the species. The subgenera are,—

Naucrates, the Pilot-fish, has spindle-shaped body, free dorsal spines, keel on the tail as in the Herring, and two free spines before the anal. The Common

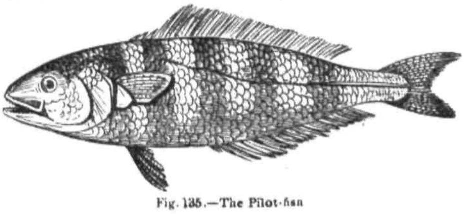
Fig. 135.—The Pilot-fish

Pilot-fish of the Mediterranean is not above a foot long; but it is swift and voracious, and follows in the wake of ships along with the Shark, which it has been erroneously supposed to lead, and hence its name of *Ductor*. A black species of the South American coasts has been found eight or nine feet long.

Eclacates, form and dorsal spines like the last, but the head flattened, and the keel and anal spines wanting.

Lichia, has dorsal and anal spines on the back, one of the former lying flat and directed forwards, but the body is compressed, and no keels on the tail. There are several species in the Mediterranean, all eatable, and some of large size. *Trachinotus* merely has the body a little more elevated, and the dorsal and anal longer and more pointed.

Rhynchobdella. Spines as in the former genus, long body, and no ventrals. The subgenera are,—

Macrognathus: has a pointed, cartilaginous muzzle, projecting beyond the lower jaw, and the dorsal and anal separate from the caudal. *Mestacembelus:* jaws equal, and dorsal and anal joined to the caudal. Both inhabit the fresh waters of Asia, and feed on worms, in search of which they plough up the sand with their cartilaginous noses: their flesh is much esteemed.

This is the place for the imperfectly known genus *Notacanthus*, which has the muzzle of the last, free spines for a dorsal, ventrals abdominal, a long anal reaching to the top of the tail, and joining a very small caudal. The known species inhabit the Arctic Ocean, and have been found two feet and a half long.

Seriola. This genus resembles Lichia, has a horizontal spine before the dorsal, but the dorsal spines united by a fin, a small fin with two spines before the anal, and no keel on the lateral line. One species is the Milk-fish of Pondicherry, so much esteemed for the delicacy of its flesh. There are several other species in both oceans.

Nomeus, resemble the last, but have large ventrals attached to the abdomen by their inner edge; colour, silvery, with transverse black bands on the upper part. Has been confounded with the Gobies.

Temnodon: tail unarmed, spines or small fins before the anal, first dorsal small, second and anal small, scales, one row of trenchant teeth in each jaw, with small crowded ones behind, and on the vomer, the parietals, and tongue; seven rays on the gills, and the gill-lid forked. There are species common to both oceans, and about the size of the common Mackerel.

Caranx, have the lateral line with scaly plates, keeled, and often spinous, horizontal spine before the first of the two dorsals, last rays of the second dorsal often detached, some spines or a small fin before the anal. Several species in the European seas, and generally over the globe. Resemble Mackerel, and are called Bastard Mackerel. [On the British shores they are designated Scad or Horse Mackerel, and they sometimes make their appearance in immense shoals, literally "banking the sea," especially along the Cornish coasts, and shores of the Bristol Channel. They feed on the fry of Herrings, and are not in much estimation as food.]

Vomer. This genus have the body more and more compressed and elevated in the different subgenera, while the armature on the lateral line diminishes, and the skin becomes smooth like satin, without any apparent scales. They have no teeth, except short and fine ones crowded together; and the subgenera are chiefly distinguished from each other by various filamentary prolongations of some of the fins. Linnæus and Bloch included them, but improperly, in the genus *Zeus* (Dory). The following are the subgenera:—

Olistus. These resemble *Situlæ*, a subgenus of Caranx, but the middle rays of the second dorsal are not branched, but merely articulated, and extend in long filaments.

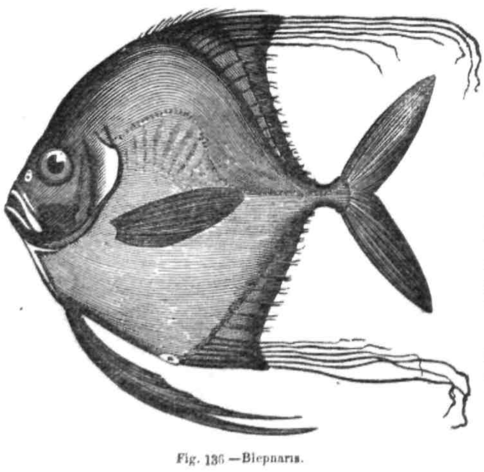
Fig. 136.—Blepharis.

Scyris. Nearly the same in form and filaments, but the spines of the first dorsal hidden in the edge of the second, and the ventrals short.

Blepharis, has long filaments to the second dorsal and anal, the ventrals very long, and the spine scarcely above the skin; their body is very elevated, but their profile not so vertical as that of some of the other subgenera found in the warm seas; and in the West Indies one species is called the "Cobbler." *Gallus*, similar to the last in all respects except having the profile more vertical. *Argyreiosus*, has the profile still more vertical, the first dorsal definitely formed, and some of its rays extended in filaments, as well as those of the second dorsal; the ventrals are also very long.

Vomer, properly so called, has the body compressed, and the profile vertical, as in the two subgenera immediately preceding it, but none of the fins are extended into filaments.

Zeus. After removing the analogous subgenera of Vomer, this genus comprehends

fishes with the mouth greatly projectile, and few and weak teeth. They differ much, and require division into various subgenera.

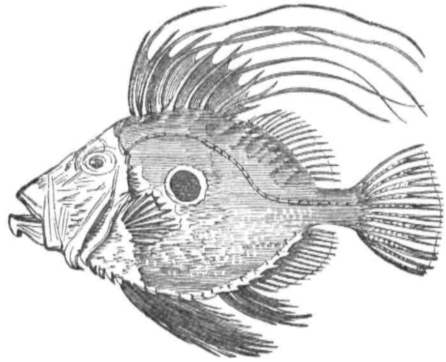

Fig. 137.—The Dory.

Zeus, the Dory, has the first dorsal deeply notched between the spines, and the intermediate membranes extend into long filaments, together with the forked spines along the bases of the dorsals and the anal. One species, the Common Dory (John Dory) is yellowish brown, with golden or silvery reflections, according to the position of the light, with a round black spot margined with white on the shoulder. [The Dory has been a renowned fish since the days of the ancients, who styled it not the fish of Jove, but *Zeus*, that is, Jove himself. The religious also claimed it as the "Tribute-money-fish," from the black marks of the thumb and fingers of St. Peter on the shoulders, in which it is the rival of the Haddock—neither of which fishes Peter had any chance of seeing. It is still held in great estimation by epicures; and being a ground fish, it keeps two or three days, and is all the better for it.]

Capras, the Boar-fish, has the notched dorsal of the Dory, but no spines along the dorsal or anal; it has the mouth still more projectile than the Dory, the body covered with rough scales, and the fins entirely without filaments. [Its flesh in little esteem.]

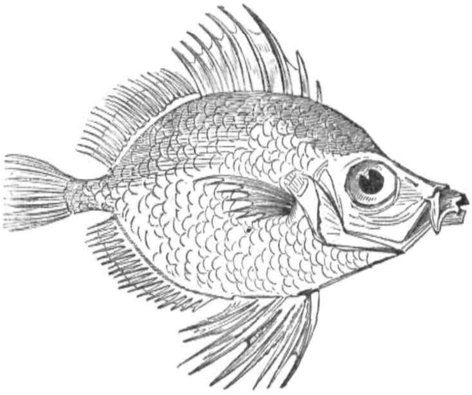

Fig. 138.—The Boar-fish.

Lampris, has a single dorsal very high anteriorly, as also is the anal, which has one small spine before its base; sides of the tail with keels; ventrals and caudal lobes very long, but subject to be worn away; colour, violet, spotted with white, and the fins red. Inhabits the Arctic seas, and grows to a large size. [In Britain it is known as the Opah, or King-fish.]

Equula. One dorsal with several spines, the foremost occasionally long, snout much protracted, body compressed, and edges of the back and belly toothed with fins. They are small fishes, several of which inhabit the Indian Ocean, and some of them have the power of contracting the snout when at rest, and projecting it suddenly for the capture of those small fishes on which they feed.

Menas, has the snout as in the last, but the body more compressed, the abdomen trenchant and very convex, but the back nearly straight; the ventrals are behind the pectorals, but still attached to the shoulder. One only is known, of the Indian Ocean, silvery, with a black spot near the back.

Stromateus. This genus has the same compressed form as Zeus, and the same smooth epidermis; but the muzzle is blunt, and not protractile. It has a single dorsal, with a few concealed spines anteriorly, but no ventrals. The vertical fins are thickened as in the scaly-finned fishes; the gullet has a number of spines attached to the membrane. They are found in the Mediterranean, the Indian Ocean, and Pacific. Some of the species differ a good deal in form.

Peprilus, has the pelvis trenchant and pointed before the vent, resembling rudimental ventrals, and some species have this part toothed.

Luvarus, resembles the former, but has no trenchant blade on the pelvis, only a small scale, which covers the vent, and a prominent keel on each side of the tail. A large species, silvery, with a reddish back, is found in the European seas.

Seserinus. All the characters of the last genus, save that there are little rudiments of ventrals. One small species is known in the Mediterranean.

Kurtus, resemble Peprilus, but differ in having the dorsal shorter, and the ventrals larger; the anal is long, and the scales so minute as to be invisible till the skin is dried. They have seven gill-rays, a spine between the ventrals, and some small trenchant plates before the dorsal, which has a spine directed forward at its base. The ribs are dilated, convex, and form a continuous annular tube, which extends so far under the tail, and contains the air-bladder. Some have a little cartilaginous horn in advance of the plates before the dorsal. They are found in the Indian seas.

Coryphæna, Dorades, or Gold-fishes, the Dolphins of the ancients, and of the modern Hollanders. They have the body long, compressed, and covered with small scales; the head trenchant in the upper

part; a single dorsal, which extends the whole length of the back, with flexible rays the whole length, but the anterior ones not jointed; and they have seven rays in the gills. The following are the sub-genera :—

Coryphæna, the Coryphene, properly so called, have the head much elevated; the profile curved, and descending rapidly; they have teeth in the palate, as well as the jaws. They are large and splendidly-coloured fishes, celebrated for the velocity of their motions, and the havoc which they commit among the Flying Fishes. [*C. hipparis*, the Common Coryphene, is found in the Mediterranean and Atlantic. It is a brilliant fish, and drives through the water like a radiant meteor. Its long dorsal is sky-blue, with the rays gold-coloured; its tail-fin green; its back green, mottled with orange; and its belly silvery, divided from the former by a yellow lateral line. As it passes along, however, there is an extraordinary play of colours upon it; and it is one of the fishes with the changes of whose colours, when dying, the luxurious Romans used to gloat their depraved fancy. Some of the Indian species are brighter coloured than this one; and, indeed, all the Scomberidæ have a tendency to get blackish in the cold seas, and brilliant in the warm ones, owing to the greater effect of the solar light in the latter; for the sunbeam is Nature's pencil, down even to the deepest fish or pearl shell].

Curanxamores, differ from Coryphene in having the head oblong, and less elevated, and the eye in a medium position. *Centrolophes*, has no teeth in the palate, and a plain space between the occiput and the dorsal. [One species, the Black Fish, *C. pompilius*, occasionally wanders from the Mediterranean to the southern shores of Britain. It is a powerful fish, and not easily caught, but its flesh is much esteemed. It feeds partially on some sea-weeds, but chiefly on other fishes.]

Astrodermus, has the head and dorsal like the Coryphene, but the mouth small, four rays in the gills, and the ventrals very small in the throat. The scales are thinly scattered over the body, arranged into stars, hence the name. Only one species is known, which inhabits the Mediterranean; is silvery, spotted with black, and has a very long dorsal. The fins are red.

Pteraclis, teeth and head like the Coryphene, but the scales larger; ventrals on the throat small; dorsal and anals as high as the fish.

[Such are the leading genera and subgenera of the Mackerel family, one of the most numerous and splendid in the class.]

THE EIGHTH FAMILY OF THE ACANTHOPTERYGII.

TÆNIDÆ (Ribbon-shaped).

This family is closely allied to the Mackerels, its first genus agreeing intimately with the last sub-genera of Scomber. The fishes composing it are long, flattened on the sides, and have very small scales. One tribe has the muzzle elongated, the mouth deeply cleft, with strong trenchant teeth, and the lower jaw projecting beyond the upper. This tribe contains only two genera.

Lepidopus, the Scabbard-fish, or Scale-foot—from the form of the ventrals, which are merely two scaly plates. The body is thin and elongated, with a dorsal above, and a low anal beneath, terminating in a well-formed caudal. The gills have eight rays; the stomach is long, with more than twenty cœca near the pyrolus; and the air-bladder is long and slender, with a glandular body attached. One species, *L. argyreus*, occurs from England to Southern Africa, but is not plentiful. It is sometimes five feet long, but it is rare. [It swims with extreme rapidity, and often with the head above water. It has no scales on the body, except the two which occupy the place of the ventral fins.]

Trichiurus, Hair-tail. The body, muzzled jaws, and teeth like the last, and a dorsal extending along the back; but no ventral, anal, or caudal fins, excepting a few obscure little spines on the under side of the tail, which terminates in a hair-like point; there are seven rays in the gills; the stomach is long and thick; the intestines striped with numerous cœca; and their air-bladder long and simple. Viewed laterally, they resemble beautiful silver ribbons. There are several species of the Indian Ocean, and one at least of the Atlantic. [One, *T. Lepturus*, called by some the Blade-fish—in contrast, we suppose, to the Scabbard-fish—occurs occasionally in various parts of the British seas. It is shining silvery, with greyish-yellow fins; the dorsal mottled with black on the edge; the irides are golden]. Some of the Indian Trichiuri have been described as having electric or galvanic properties, but such is not the fact.

A second tribe comprehends genera which have the mouth small, and little cleft.

Gymnetrus, has the body elongated, and flat, without an anal fin, but with a long dorsal, a caudal composed of few rays, and ventrals under the pectorals, which are fibrous, with small expansions at their extremities, but both they and the anterior of the dorsal are liable to be broken. The fishes themselves are very tender, their bones soft, their fins easily rent, and their flesh soon decomposed. They occur in the Mediterranean, the Indian, the Atlantic, and the Arctic Seas. Some of them are ten feet in length. [Two species have occurred in the British seas:—*G. Hawkensii*, on the coast of Cornwall, and *G. arcticus*, on some of the northern coasts; but the last species is not very satisfactorily made out, as the tenderness of the fish causes it to be mutilated almost the instant it is stranded.]

Stylephorus, has a caudal fin, as in the last, but shorter; and instead of the tail ending in a hook in the middle of the fin, as it does there, it is produced in a filament longer than the body.

A third tribe has the muzzle snort, and the mouth cleft obliquely. It contains three genera.

Sepola, have a long dorsal and anal, the top of the cranium flattened, the gape inclining upwards, all the spines of the dorsal flexible, but those of the ventrals stiff, cavity and stomach very short, and the air-bladder extending as far as the tail. One species, of a reddish colour, inhabits the Mediterranean; [and is occasionally found on the south coast of England, where it is known as the Red-band Fish, or Red Snake-fish. They appear to have little command of themselves in a stormy sea]. *Lophotes*, head short, with an osseous crest surmounted by a spine, bordered behind this with a low fin, extending from this spine to the tail, which has a very small caudal; the anal very short, pectorals moderate, and scarcely any ventrals; teeth pointed, eyes very large, and abdominal cavity occupying nearly the whole length of the body. One species is known in the Mediterranean, where it attains a large size.

THE NINTH FAMILY OF THE ACANTHOPTERYGII.

THEUTYES (the LANCET-FISH Family).

These agree with the Mackerel family in some respects, but differ in others, such as trenchant spines on the sides of the tail, and an horizontal spine before the dorsal. The family contains few genera, all foreigners, with compressed oblong body, small mouth, slightly or not at all protractile, and only a single row of trenchant teeth in the jaws. They feed chiefly on fuci and other marine plants, and have large intestines. [Their powerful spines, which they use very dexterously, are weapons of defence supplied to them for nearly the same purposes as the horns of the ruminant Mammalia.]

Siganus, have a unique character in their ventrals, which have two spinous rays, one external and the other internal, and three branch rays between them. They have five gill-rays, a horizontal spine before the dorsal, and the styloid bones of the shoulder so curved as to unite at their extremities with the first interspiral bone of the anal. There are numerous species in the Indian Ocean.

Acanthurus, Lancet-fishes, have the teeth trenchant and notched, and a strong spine at each side of the tail, as sharp as a lancet, with which they inflict severe wounds on such as attempt to handle them unwarily; hence their common name. They are found in the warm parts of both oceans: some with the dorsal very elevated, others with a tuft of bristles before the lateral spine, and others again with the teeth divided like a comb.

Prionurus, differ from the last only in having a number of horizontal cutting-blades on the side of the tail, in place of the strong spine. [These might be termed Scarifiers.]

Naseus, have trenchant blades in the tail like the last, but with conical teeth, and a prominent horn projecting over the muzzle; only four rays in the gills, and three in the ventrals. Their skin is leathery.

Axinurus, more elongated than the last, and without the prominence in front, but with the same number of rays in the gills and ventrals; on each side of the tail, they have a single square cutting-blade, without a basal shield; their mouths are small, and their teeth slender.

Priodon, have the notched teeth of Acanthurus, the three soft ventral rays of Naseus, and the sides of the tail armed like Syganus.

THE TENTH FAMILY OF THE ACANTHOPTERYGII.

FISHES WITH LABYRINTHS IN THE PHARYNX.

By the term *Pharyngina labyrinthiformæ*, is meant that the upper membranes of the pharynx are divided into small irregular leaves, more or less numerous in the different genera, containing cells between them, which the fish can at pleasure fill with water; and by ejecting a portion of this water, moisten its gills, and thus continue its circulation while out of its proper element. [From this contrivance of Nature herself, we are to understand that, if the gills of a fish can be kept properly moistened, by salt water or by fresh, according as the fish is naturally an inhabitant of one or the other, it may be carried alive over land to an indefinite distance]. By means of this apparatus, these fishes are enabled to quit the pool or rivulet which constitutes their usual element, and move to a considerable distance over land. This singular faculty was unknown to the ancients; and the people in India still believe that these fishes fall from heaven.

[In cold and temperate climates, this apparatus is not necessary, because all the ponds and streams there, which are capable of supporting fish, are perennial, and never dried up, except in seasons of extreme drought, when, of course, all the fishes perish; but in tropical countries, and in India perhaps above all other tropical countries, where the seasons are alternate drought and rain, there is neither food nor water for a fish during the one season, and plenty of both during the other. Hence, these fishes are furnished with this peculiar apparatus in the pharynx, by means of which they are enabled to follow the water over dry obstacles, and, in some of the species, to climb steep banks, or even trees in the course of their instinctive journeys]. The following are the genera:—

Anabas, the Climbing Perch of India. This genus has the labyrinths highly complicated; the third pharyngi have pavement teeth, and there are others behind the cranium; the body is round in the section, and covered with strong scales; the head is large, the muzzle short and blunt, and the mouth small; their lateral line is interrupted for the posterior third; the margins of the operculum, super-operculum, and inter-operculum, are strongly toothed, but there are no teeth in the pre-operculum; their gills have five rays; they have many spinous rays in the dorsal and anal; and their stomach is of middle size, rounded, and with three cœcular appendages to the pyrolus. Only one species is known, which not only quits the water, and moves over banks, but is said by Daldorf to climb bushes and trees, by means of its dorsals and the spines on the gill-lids; but others dispute the latter power. This species is very common in India.

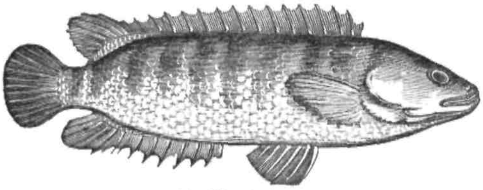

Fig. 139.—Anabas.

Polyacanthus, has the spinous rays as numerous as the last genus, or even more so; and the same mouth, scales, and interrupted lateral line, but the gill-lid is not toothed; the body is compressed; there are four rays in the gills, a narrow band of small crowded teeth in the jaws, but no palatal teeth; the labyrinths are less complicated, and the pyrolus has only two cœcular appendages.

Macropodus, differs from the last in having the dorsal less extended, and that in the caudal and ventral ending in slender points; the anal is also larger than the dorsal.

Hesostoma, have a small compressed mouth, so protractile as to advance from and retreat to the suborbitals; they have small teeth on the lips, and some on the jaws of the palate; five gill-rays, on the arches of which, towards the mouth, there are lamellæ resembling the external ones; the stomach is small, and has only two pyrolic cœca, but their intestine is long; the air-bladder is very stout.

Osphromanus [so called from a conjecture, apparently erroneous, that the labyrinths of the pharynx are organs of smell], resembles Polyacanthus, but has the forehead concave; the anal longer than the dorsal; the suborbitals, and inferior edge of the pre-operculum, finely toothed; the first soft ray of the ventrals very long; six gill-rays; the body much compressed. One species, *O. alfax*, grows as large as a turbot, and is considered more delicious. It has been introduced into ponds in the Isle of France and Cayenne, where it thrives well. The female, as in many other species of fish, digs a cavity in the sand for the reception of her eggs.

Trichopodus, has the forehead more convex than the last, a shorter dorsal, and only four gill-rays. The only known species is a small fish from the Oriental Isles, of a brownish colour, with a dark spot on the side.

Spirobranchus, resembles Anabas, but has no teeth on the gill-lids, but teeth in the palate. The only known species is a minute fish of Southern Africa.

Ophicephalus, like the rest of the family in most of its characters, especially in the pharyngeal labyrinth, and can creep for some distance over land; but it differs from all other Acanthopterygii in having no spines in the fins, except a short one on the first of the ventrals. The body is long, and nearly cylindrical; the head flat, and covered with polygonal plates; the dorsal extends nearly the whole length; the anal is also long, and the caudal round it; they have five gill-rays; the stomach is obtuse, with moderately long cœca; and the abdominal cavity extends nearly to the base of the caudal. They are found in India and China, of various species, and different sizes. In the former country, the jugglers, and even the children, amuse themselves by making it crawl along upon dry ground; and in China, the larger ones are cut up alive for sale in the markets.

[All the genera and species of this family are fresh-water fishes; and they have not hitherto been found except in the south-east of Asia and the adjacent islands, and in Southern Africa.]

THE ELEVENTH FAMILY OF THE ACANTHOPTERYGII.

MUGILIDÆ (the MULLET Family).

This family consists of the following three genera :—

Mugil, the Mullet, properly so called, [which must not, however, be confounded with the Red Mullets, either plain or striped, which are included in the Perch family]. Their organization has so many peculiarities that they might be formed into a separate family. Their body is nearly cylindrical, covered with large scales, two separate dorsals with only four spinous rays in the first, and the ventrals are a little in rear of the pectorals. Their head is a little depressed, covered with large angular scaly plates; their muzzle is short; their form is an angle, in consequence of a prominence at the middle of the lower jaw; and their teeth are very small, and in some almost imperceptible. They have six gill-rays; the bones of the pharynx give an angular form to the gullet; their stomach terminates in a fleshy gizzard, resembling that of a bird; they have few cœcal appendages, but the intestinal canal is long and doubled. They are gregarious, resorting to the mouths of rivers in large troops, and constantly leaping up out of the water. [They feed in part upon small Crabs and other Crustacea, which

they swallow entire]. There are several species found in the European seas, of which the flesh is much esteemed.

M. cephalus, the Grey Mullet, has the eyes half covered by two adipose membranes, adhering to the anterior and posterior margins of the orbit; when the mouth is closed the maxillary is completely hidden under the suborbital; the base of the pectoral has a long crest with a keel; the nostrils are separated by a considerable space, and the teeth are a little prominent. It is the largest and best of the Mediterranean species. [It occurs also on the British shore, though, perhaps, not so frequently as another species, the Thick-lipped Grey Mullet, *M. chelo*. The two are, however, sometimes confounded with each other. In addition to these, there is another Grey Mullet, first described by Mr. Yarrell, and which, from its shortness in proportion to the length, he has called *M. curtus*. With the exception of its form, its small size, and some difference in the rays of the pectoral, anal, and caudal fins, it bears considerable resemblance to *M. cephalus*.]

M. capito, the Ramando of Nice, has the maxillary visible behind the commissure of the jaws, even when the mouth is shut; its teeth are much weaker: its nasal openings nearer to each other; and the membrane of the eye does not cover any part of the ball. The scale before the pectoral is short and blunt, and there is a black spot at the base of that fin.

Two much smaller species (*M. aureus* and *M. saltator* of Risso) resemble *M. capito*. The first has the maxillaries under the suborbitals, like Cephalus, but the nostrils are near each other, as in Capito. The second, with the characters of Capito, have the suborbital notched, showing the maxillary.

M. chelo, is common in the Mediterranean and the Atlantic. It is easily distinguished by its thick fleshy lips, by their ciliated edges, and by the teeth which penetrate their substance like hairs. The maxillary is curved, and appears behind the commissure. *M. labio*, a small American species, has proportionally larger lips, with their margins curved. There are also some thick-lipped species in the Indian seas. [There seems little doubt that Chelo is the Grey Mullet, which is so frequently taken in the bays and estuaries on the Channel coast, although not the one generally described as such].

Tetragonurus, is so named from the projecting keels or ridges on each side, near the base of the caudal. It is also one of those insulated genera which indicate particular families, [rather than belong to any of those established ones]. They in part resemble the Mullets, and in part the Mackerels. Their body is elongated; their spine is dorsal, long, but very low; their soft dorsal, which approaches the other, higher and shorter; their anal is opposite the soft dorsal, and their ventrals a little behind the pectorals; the sides of the lower jaw are raised vertically, and furnished with a single row of trenchant teeth like a saw, and inclosed, when the mouth is shut, by the upper teeth; there is also a small range of teeth upon each parietal bone, and two on the vomer; the gullet is furnished internally with hard and pointed papillæ; their stomach is fleshy, and doubled; their cœca numerous, and their intestinal canal long. Only one species is known, an inhabitant of the Mediterranean, about a foot long, and black: its flesh is believed to be poisonous.

Atherina, is a genus which does not completely harmonize with any other, and therefore it is arranged between the Mullets and the Gobies. It has a lengthened body, two dorsals far apart, ventrals behind the pectorals, the mouth protractile, and furnished with very small teeth. All the known species have a broad silvery band along each flank. They have six gill-rays; their stomach is a cul-de-sac, and no cœcular appendages. The last transverse process of the dorsal vertebræ are bent, forming a sort of conical receptacle for the end of the air-bladder. They are small fishes, much esteemed for the delicacy of their flesh; and the fry remain a long time in shoals along the shores, and are consumed in great numbers. Four species are found in the Mediterranean, and there are a good many foreign ones. [*A. presbyter*, is found on the south coast of England, and also on the east coast as far as Lincolnshire, and in the Firth of Forth, but not abundantly. On the coasts of Hampshire and Sussex it is plentiful; and on the Cornish coast it is taken at all seasons. It is a handsome little fish, about six inches long, known as the Sand Smelt, but inferior in flavour to the true Smelt.]

THE TWELFTH FAMILY OF THE ACANTHOPTERYGII.

GOBIODÆ (the GOBY Family).

The fishes of this family are known by the thinness and flexibility of their dorsal spines. They all have the same kind of viscera,—namely, a long, uniform, intestinal canal, without cœca, and no air-bladder. [The family contains several genera, some of which admit of subdivision].

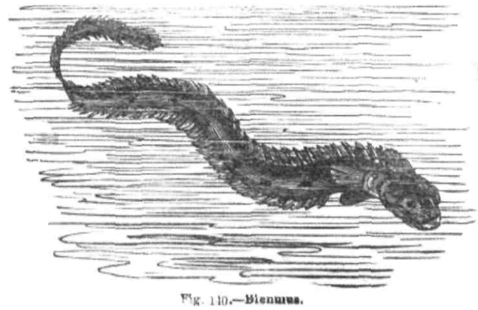

Fig. 110.—Blennius.

Blennius. The Blennies have one well-marked character in their ventral fins, inserted before the pectorals, and having only two rays each. The stomach is slender, with no cul-de-sac; the intestine large, without cœca, and there is no air-bladder. The form is elongated and compressed, and there is but one dorsal, composed almost entirely of jointless but flexible rays.

They live in small troops, among rocks near the coast, swimming and leaping, and can exist for some time without water. Their skin is covered with a mucous secretion, whence they have their common name Blennies. Many of them are viviparous, or bring forth their young alive, fully formed, and capable of subsisting by themselves. They are divided as follows :—

Blennies, properly so called, have the teeth equal and closely set, forming only a single and regular row in each jaw, but terminating behind, in some of the species, by a longer and crooked tooth; their head is blunt, their profile vertical, and their muzzle short. Most of them have a fringed appendage over each eye, and some have another on each temple. Their intestines are wide and short. The following are some of the more remarkable species :—*B. ocellaris*, Ocellated Blenny, or Butterfly-fish. This has two lobes in the dorsal, the first marked with a round black spot surrounded by a white ring, and then a black one. It is a native of the Mediterranean, [but is occasionally found in the South of England by dredging. It lives among the rocks and sea-weed, and is understood to feed on minute Crustacea and Mollusca. It spawns in spring. It is a very small fish.] *B. tentacularis* has four filaments on the head, the dorsal fin even, and a black spot on the fourth and fifth rays. [It is not named among the English Blennies.] *B. gattorugine*, has the dorsal nearly even, and only two fillets on the head. [It is found on the Cornish shores, varying in length from one inch to five. The general colour is reddish-brown, paler on the belly.] *B. palmicornis*, has the appendage over the eye fringed, and the dorsal almost quite even, the anal long, and the caudal rounded: [it is found on various parts of the British shores, and even as far north as Norway. It is usually of small size, and pale brown, mottled with dark dull brown]. In some the appendages over the eyes are hardly visible, but they carry a prominent membrane on the top of the head, which becomes red and inflated in the pairing season. Of these there are several in the European seas. *B. galerita*. [Head blunt and rounded, body smooth, compressed, and clammy, one long dorsal fin, ventrals before the pectorals, with only two rays each, and both joined at the base. This is an insignificant species, found occasionally on the British shores, but, like most of the genus, quite valueless.] *B. rubiceps*, has the first three rays of the dorsal elevated, with red points, and the top of the head of the same colour. *B. pholis*, has the head without any appendages, the dorsal notched, and the pectorals rather large. [It is found on the British shores, and is remarkably tenacious of life, being capable of living a good many days if kept in moist grass or moss : like the rest, it is of trifling value.]

The following subgenera are separated from the Blennies, properly so called :—

Myxodes, with the head lengthened, the muzzle pointed, and projected in advance of the mouth; a single row of teeth, but no large or canine ones.

Salarias, have the teeth in a single row, placed close, hooked, but very slender and numerous. In a recent specimen they yield to the touch like the keys of a musical instrument. The head is much compressed above, and enlarged transversely below; their lips are fleshy and thick; their profile is quite vertical. Their intestines have spiral convolutions, and are longer and more slender than in the Common Blenny. They are found in the Indian Ocean only.

Clinus, have short pointed teeth, dispersed in several rows; their muzzle is less obtuse than in the former; the stomach is more ample, and the intestines shorter. There are some variations of character.

Cirrhibarba, resembles Clinus in shape, has small curved teeth, a little filament over the eye, one in the nostril, three larger ones at the end of the muzzle, and eight under the point of the lower jaw. Found in India.

Murænöides, the Spotted Gunnel, or Butter-fish, has the ventral smaller than in any of the rest, often only a single ray; head small; body lengthened like a sword-blade; a low dorsal, extending the whole length of the back; teeth like Clinus; and the stomach and intestine have a uniform appearance. [Found generally in the European seas, even as far north as Greenland, where it is eaten. There it is said to grow to the length of ten inches, but on the British shores it is seldom more than six. The mucous secretion of the skin is very copious.]

Opistognathus, resembles the true Blennies in form, especially its short snout; has large maxillaries prolonged backwards to a sort of moustache; teeth rasp-like, the external row strongest; three rays in the ventrals, which are directly under the pectorals. From the Indian Ocean.

Zoarcus. These cannot be separated from the Blennies, though they have no spinal ray, for they have all the more essential characters; [one species, *Z. viviparens*, is very common on the British shores, especially the north and east; it is easily taken about the season when charlock is in flower in the corn-fields; but it is of little value, and generally disliked, because when boiled its bones turn green. It attains the length of seven or eight inches, and the female brings forth her young alive. The body is heavy and lumbering, for so small a fish. *Z. labrosus* is an American species, of an olive colour, with brown spots, and it sometimes attains the length of three feet.]

Anarrichas. [So very similar did Cuvier consider these fish to the Blennies, that he was disposed to consider them as Blennies without ventral fins.] Their dorsal fin is composed entirely of simple but not stiff rays, and extends, as does also the anal, very close to the base of the caudal, which last, as well as the pectorals, is rounded The whole body is soft and slimy. Their parietal bones, vomer, and mandibles, are hard, with stout bony tubercles, surmounted by small enamel teeth; but their front teeth are much larger and conical. This structure of the teeth gives them an armature, which, added to their large size, makes them both fierce and dangerous fishes. They have six rays in the gills; stomach short and fleshy, with the pyrolus near its base; the intestines short, wide, and without cœca; and they have no air bladder.

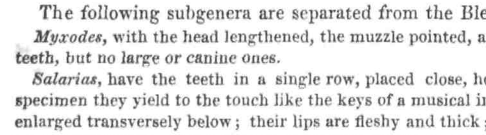

Fig. 141.—Anarrichas lupus.

A. lupus, the Sea Wolf, or Sea Cat, is the most common species: it inhabits the north seas, and is very often met with; attaining the length of six or seven feet. Its colour is brown, clouded with darker. Its flesh resembles that of an Eel. It is very valuable to the Icelanders, who salt its flesh for food, employ its skin as shagreen, and make use of its gall as soap. [This large and formidable species is almost exclusively confined to the northern seas, and in appearance it is a very repulsive fish. Its body is thick and lumbering, while the form of the pectorals, the colours of the front, the proximate position of the eyes, and the great teeth, give it much the appearance of a Cat, or even of one of the more formidable animals of that family. Its manners accord with its aspect, for it is remarkably strong, very active, and equally ready to defend itself or attack an enemy. It often enters the fishermen's nets for the purpose of plundering them of the entangled fish; and when the fishermen attack it, and it cannot dart through the net, it fights like a Lion. They maul it with handspikes, spars, and such heavy timber as they may have in the boats; but even when it is landed, and apparently dead, they are not quite safe from its bite. On the east coast of Scotland, it is a frequent though by no means a welcome visitor; and though those who can overcome their aversion to its appearance find it wholesome and light food, yet it is a fish which the majority would not receive gratis. It deposits its spawn in early summer, among the sea-weed, and is understood to prey indiscriminately upon Fishes, Crustacea, and shelled Mollusca, its jaws and teeth being capable of breaking the hardest shell. In the Arctic seas, which are its appropriate localities, it grows to a greater size than on the British shores.]

Gobius, the Gobies, or Sea Gudgeons, are easily recognized by the union of their ventrals, which are thoracic, and united either for their whole length, or at their bases, into a single hollow disc, more or less funnel-shaped. The rays of the dorsal are flexible, their gills have five rays only; and, like the Blennies, they have but little gill-opening: they can live for some time out of the water. Like the Blennies, also, their stomach has no cul-de-sac, and their intestines no cœca. In their reproduction they further resemble the Blennies; and some species, as in these, are known to be viviparous. They are small or middle-sized fishes, which live among rocks near the shore, and most of them have a simple air-bladder.

They admit of division into the following subgenera:—

Gobius, comprehending the Gobies, properly so called. They have the ventrals united for the whole of their length, and also a transverse membrane joining their bases in front, so as to form the whole apparatus into a concave disc. The body is lengthened, the head moderate and rounded, the cheeks turgid, and the eyes near each other, and they have two dorsal fins, the last of which is very long. Several species inhabit the European seas, the characters of which are not sufficiently ascertained. They prefer a clayey bottom, in which they excavate canals, and pass the winter in them. In spring they prepare a nest in some spot abounding with sea-weed, which they afterwards cover with the roots of *Zostera* (grass-wrack). Here the male remains shut up, and awaits the females, which successively arrive to deposit their eggs; and these he fecundates, and exhibits much solicitude and courage in defending them from enemies. The Goby is the *Phycis* of the ancients; according to Aristotle, " the only fish that constructs a nest."

G. niger, the Black Goby, or Common Goby, is the one most frequent on European shores. [It is only about five or six inches long, and of scarcely any value, except as food for other fish. The margins of the united ventrals form almost a perfect oval, and there is a tubercle behind the vent, the use of which is conjectured, but not known. In the Mediterranean the species are much more numerous, have considerable variety of colour, and one, the Great Goby (*G. capito*) grows to the length of a foot or more. Other British ones are, the Two-spotted Goby, a small species with one dark spot under the base of the first dorsal, and another on the base of the caudal,—this is not above two or three inches long; the Spotted Goby, about three inches long, yellowish, with pale rust-coloured spots, very abundant in estuaries, or on shallow shores, and used by fishermen as bait; and the Slender Goby, similar to the preceding in colours and in length, but much more slender in the body. The habits of all are nearly the same.]

Other subgenera are,—*Gobiodes*, which differ from the Gobies in nothing but having one dorsal fin. *Tenioides*, more lengthened in the body; the lower jaw elongated, and rising over the upper one; tongue very fleshy; some cirri on the lower jaw; eyes extremely minute, and almost hidden. *Periopthalmus:* the entire head scaly; eyes with a moveable underlid; the pectorals scaly for more than half their length, which gives them the appearance of having wrists. [Indeed, this species leads naturally to the structure and habits of the family next to be noticed]. Their gill-openings are still smaller in proportion than those of the Gobies; and they can live for a longer time out of the water. In the Molucca Islands, which they inhabit, they may be seen creeping and leaping over the mud, either to escape from enemies, or to seize upon the minute Crustacea which constitute their food. *Eleotris*, have, like the Gobies, flexible spines in the first dorsal, and an appendage behind the vent; but they have the ventral fins separate, and six gill-rays. They inhabit chiefly the fresh waters of warm countries, and lurk in the mud. One, *E. dormatrix*, the Sleeper, from the West Indian marshes, is tolerably large; and others have been found in Africa, in India, and in the Mediterranean.

Callionymus, have two very striking characters: their gill-openings are only a hole on each side of the nape, and their ventrals are placed under the throat, separate, and larger than the pectorals. The head is oblong, depressed, and with the eyes directed upwards; their intermaxillaries are very protractile, and their pre-operculi are lengthened backwards, and terminate in some spines; their teeth are small, and thickly set, and they have none in the palate. They are finely-coloured fishes, with the skin smooth; the first dorsal supported by setaceous rays,

the first of which reaches backwards nearly to the tail; and the second dorsal and the anal have also the rays considerably elongated. They have neither cul-de-sac to the stomach, cœca, nor air-bladder.

One species, *C. lyra*, the Dragonet, is common in the British Channel, [and not rare on many parts of the British coast, even as far north as the Orkneys. The prevailing colour is yellow, with spots of brownish yellow, whence some of the common names of the fish. It frequents the shallow waters, feeding on Crustacea, Mollusca, and Worms; and answering little purpose, save as food for more valuable fish. Its flesh is said, however, to be firm and good. *C. dracunculus*, the Sordid Dragonet, is more dingy in colour, and has the rays of the first dorsal much less produced. It was once supposed to be the female of the other species, but the mistake has been found out and rectified. There are some subgenera nearly allied to Callionymus.]

Trichonotes, differs not much from the last, except in having the body very long, a single dorsal, and the anal proportionally longer. The first two rays of the dorsal are extended in long threads, representing the first dorsal of the former. It is said that the gill-openings of this subgenus are tolerably wide.

Comephorus, have the first dorsal very low; the muzzle oblong, depressed, and broad; the gills with seven rays, and large openings; the pectorals very long; and (which distinguishes them from the rest of the family) they have no ventrals whatever. The known species is found in the fresh-water lake of Baikal. It is a foot in length, very soft and greasy in its substance, and pressed for obtaining an oil. It is not fished for in the lake, but found dead on the shores after storms, which are there severe and frequent.

Chirus, are fishes with the body rather long, small ciliated scales, a small unarmed head, a shallow mouth, with small and irregular conical teeth. The spines of the dorsal are always slender, and that fin extends along the whole back. Their distinguishing character is several series of pores, extending along the side, and having some resemblance to additional lateral lines. All the known species inhabit the Sea of Kamtschatka.

THE THIRTEENTH FAMILY OF THE ACANTHOPTERYGII.

PECTORALES PEDUNCULATI (Fishes with Wrists to the Pectoral Fins).

There are some spinous fishes in which the carpal bones are so elongated as to form a sort of arm or wrist, to the extremity of which the pectoral fin is articulated. The family consists of two genera, closely allied to each other, though authors have sometimes placed them far apart in their arrangements; and they are also related to the Gobies, [particularly to *Periopthalmus*, already noticed. This is a very peculiar structure of the fins; gives these fishes a strange appearance, and enables them, in some instances, to leap suddenly up in the water, and seize prey which they observe above them; and in others to leap over the mud, somewhat after the manner of Frogs.]

Lophius, Anglers.—The distinguishing character of these, besides their demi-cartilaginous skeleton, and their skin without scales, consists in the pectoral being supported as by two arms, each consisting of two bones, which may be compared to the radius and ulna of an arm, but which in reality belong to the carpus, or wrist; and in this genus they are larger than in any other They are also characterized by having the ventrals placed much in advance of the pectorals; and by having the operculum and the gill-rays enveloped in the skin, so that the gill-opening is merely a hole situated behind the pectoral. They are voracious fishes, with a large stomach and a short intestine; and they can live a long time out of the water, in consequence of the small size of their gill-openings. They admit of division into three subgenera.

Lophius, head excessively large compared to the body; very broad, depressed, and spinous in many parts; the mouth deeply cleft, and armed with pointed teeth; and the lower jaw fringed round with many fleshy barbules. They have two dorsal fins, and some rays of the first are free, and move on the bones of the head, where they rest on a horizontal interspinal process. [In the Angler, or Fishing Frog of the British seas, the motions of these detached rays are very peculiar. Two are considerably in advance of the eyes, almost close to the upper lip; the posterior of these is articulated by a stirrup upon a ridge of the base, but the anterior one is articulated by a ring at its base, into a solid staple of the bone, thus admitting of free motion in every direction, without the possibility of displacement, except in case of absolute fracture. The third one, which is on the top of the cranium behind the eyes, is articulated much in the same manner as the posterior one of the other two; and of course, though these two have considerable motion in the mesial plane of the fish, they have very little in the cross direction. The one near the lip, however, can be moved with nearly the same ease and rapidity in every direction; and while the others terminate in points, it carries a little membrane, or flag, of brilliant metallic lustre, which the fish is understood to use as a means of alluring its prey; and the position of the flag, the eyes, and the mouth, certainly would answer well for such a purpose]. The gill-membrane forms a large sac, opening in the axilla of the pectorals, supported by six very long rays, and with a small operculum. They have only three gills on each side. It is said that these fishes lurk in the mud, where, by agitating the rays on their heads, they attract smaller fishes, which mistake the appendages upon the rays for worms, and which are instantly seized, and transferred to the gill-sac. Their intestines have two or three short cœca near the commencement, but the fishes have no air-bladders.

L. piscatorius, the Fishing Frog, Sea Devil, and many other local names, attains sometimes the length of four or

five feet; and the extreme hideousness of its appearance has procured it some celebrity. [There are few parts of the muddy shores of the British islands where these ugly and voracious fish are not to be met with; and such is its propensity to keep its great mouth in exercise, that when captured in a net along with other fishes, it speedily begins to swallow its companions, especially if Flounders, which appear to be its favourite food. On some coasts, it is sought for on account of the live fish in its stomach, its own flesh being but small in quantity, and held in little estimation. Another European species, *L. palviparus*, has its second dorsal lower, and five vertebræ fewer in the spine.

Chironectes. These have, like the last genera, free rays on the head, of which the first is small, and often terminating by a tuft; and those behind it are enlarged by a membrane, which is sometimes very broad, and at other times they are united into a fin. Their body and head are compressed, and their mouth opens vertically. Their gill membranes have four rays, and have no opening but a small hole behind the pectorals. Their dorsal extends along the whole back, and they often have cutaneous appendages all over their bodies. They have four gills, a large air-bladder, and a moderate intestine without cœca. They can inflate their great stomach with air, in the same manner as the Tetrodons blow up their bellies like balloons. On the ground, their two pairs of fins enable them to crawl along like little quadrupeds; and the pectorals, in consequence of their position, perform the functions of hind legs. They can live out of the water for two or three days. They are found only in the seas of warm countries, and Æneas confounded many of them under the name *L. histrio*. [In some of the muddy estuaries on the north coast of Australia, from which the tide ebbs far back in the dry season, these Frog-fishes are so abundant, and capable of taking such vigorous leaps, that those who have visited the places have, at first sight, taken them for birds.] One might separate the species in which the second and third rays are united into a fin, and sometimes also joined to the other dorsals.

Malthus. These have the head greatly extended and flattened, principally by the projection of the sub-operculum; the eyes are forwards; the snout projecting, with a little horn; the mouth under the muzzle, of mean size, and protractile; the gills sustained by six or seven rays, and opening by a hole above each pectoral. They have a simple dorsal, which is soft and small; and there are no free rays in the head. The body is studded with osseous tubercles, and bordered round with cirri. They have neither cœca nor air-bladder.

The remaining genus of this family is *Batrachus*, the Frog-fishes, properly so called. They have the head flattened horizontally, and much larger than the body; the gape deeply cleft; the operculum and sub-operculum spinous; six gill-rays; the ventrals straight, attached under the throat, with only three rays, of which the first is broad and lengthened: the pectorals are carried by a short arm, resulting from an elongation of the carpal bones: their first dorsal is short, supported by three spinous rays; the second is soft and long, and has the anal corresponding to it; their lips are often garnished with filaments; their stomach is an oblong sac; their intestines are short, and without cœca; and their air-vessel is anteriorly deeply forked. They lurk in the sand, in order to swallow small fishes, in the same manner as the members of the last genus; and it is thought that wounds inflicted by their spines are dangerous. They inhabit both oceans. In some, the scales are smooth, and they have a membrane over the eye; others are scaly, and want that membrane. [None of them appear in the authenticated lists of British fishes.]

THE FOURTEENTH FAMILY OF THE ACANTHOPTERYGII.

LABRIDÆ (the WRASSE, or ROCK-FISH Family).

This family are easily known by their appearance. They have an oblong body, covered with scales; and a single dorsal, supported anteriorly by spinous rays, often furnished with membranous laminæ. The jaws are covered by fleshy lips. There are three bones in the pharynx,—two upper ones attached to the cranium, and a large under one. All the three are furnished with teeth, arranged like a pavement in some, and pointed, or in laminæ, in others; but generally stronger than is usual in the class of Fishes. Their intestinal canal is either without cœca, or with two small ones; and they have a large and strong air-bladder. They admit of division into various genera and subgenera.

Labrus, or Lipped—that is, Thick-lipped—Fishes. A very numerous genus, the species of which much resemble each other in their oblong form, and in their double fleshy lips, from which they receive their name. One of these lips adheres immediately to the jaw-bones, and the other to the suborbitals. They have thickly-set gills, with five rays. Their conical maxillary teeth (of which the middle and front ones are the largest), and their cylindrical teeth in the pharynx, are arranged like a pavement,—the upper ones with two large plates, and the under with one only, which fits to the others. Their stomach has no cul-de-sac, but is continued in an intestine without cœca, which, after two reduplications, terminates in a wide rectum. The air-bladder is single, and strong. There are several subgenera.

Labrus, properly so called, vulgarly termed "Old Wives of the Sea." They have no spines or notches in the operculum or pre-operculum, and the operculum and cheek are covered with scales. The lateral line is nearly straight. The European seas furnish several species, which, from variations of colour in the same species, are not easily distinguished from each other. *L. maculatus*, the Balloon Wrasse, is a foot or eighteen inches long, with twenty or twenty-one spines in the dorsal; blue or greenish above; white below; marked all over with yellow, and

sometimes the yellow colour predominates. [This species is numerous upon the British shores, though they are not very often caught; and from the variations of their colours they are not easily identified. They frequent deep pools among the rocks, hide themselves in fuci, and are understood to feed chiefly on Crustacea. If the fishermen know their haunts, they take a bait freely; and, according to the report of Mr. Couch, the first taken are always the largest. They frequent the rocky shores only. They spawn in April; and the fry, which are then of small size, remain among the rocks during the summer. It is understood that the blue colour, which appears to be characteristic of the high condition of the fish, is very evanescent. *L. lineatus*, the Lineal-streaked, is more clouded; has irregular bands along the flank, the ground of which is reddish; and the dorsal spines are less numerous, and the soft part of the fin lower, than in the former species. This species is named as a British fish, but it appears to be exceedingly rare. *L. variegatus*, the Blue-streaked, is one of the most beautiful of the family, of an orange red, paler on the belly, having the sides and irides striped with fine blue. The lips are capable of great extension, and there is a single row of pointed teeth in each jaw. It is found in the British seas, but only on the south and south-west coasts. *L. vetula*, is also named as a British fish. It is dark purple, black on the upper part, paler on the belly, and has the fore part of the head flesh-coloured, tinged with purple, and the eyelid blue. Few specimens have been met with on the British shores, and those of comparatively small size. Perhaps it is the *Merula* of Gmelin. *L. carneus*, the Three-spotted Wrasse, reddish in the colour, with four light spots, and three black ones intermediate, extending from the middle of the dorsal to the root of the caudal. It belongs to the Mediterranean, but has been found on the Channel-coast of England, in the Firth of Forth, and even on the coast of Norway, and in the Baltic. There are various other species; but, as we have said, they are not easily distinguished from each other, in consequence of the change of colour to which they are subject.]

Cheilinus, differs from Labrus, properly so called, in having the lateral line interrupted at the end of the dorsals, where it recommences a little lower down. They are beautiful fishes, inhabiting the Indian seas.

Lachnolaimus, (Captains), have the general character of Labrus; but their pharynx has no pavement-like teeth, except in the posterior part,—the remainder of them, as well as a part of the palate, being covered with a villous membrane. They are easily known by the first spines of the dorsal, which extend in long flexible threads. They are American fishes.

Julis, have the head entirely without scales, and the lateral line forming a curve near the end of the dorsal. There are some in the Mediterranean, but they are more numerous in the tropical seas. [They are generally small but beautiful fishes: some are violet, some bright scarlet, some rich green, and some marked with golden colour; and those which have the caudal fin rounded, or truncated, have the first dorsal rays extended in long filaments.]

Anampses, have the character of the last, with the exception of two flat teeth, which project from the mouth, and curve upwards. The two known species are from the Indian seas.

Crenilabrus. These fishes are separated from the *Lutjanus* of Bloch, to arrange them in their proper place. They have the true characters of Labrus, both external and internal; and differ only in having the border of the pre-operculum toothed. Some species are found in the North Sea, such as *Lutjanus rupestris* of Bloch, yellow, with clouded bands ranged vertically, and blackish; *L. norvegicus*, brownish, irregularly marked with deep brown; *L. melops*, orange, spotted with blue, and a black spot behind the eye; *L. exoletus*, remarkable for five spines in the anal fin. The Mediterranean furnishes a number, most beautifully coloured, the most splendid of which is *L. lapina*, silvery, with three broad longitudinal bands, composed of vermillion dots, with the pectorals yellow and the ventrals blue. They are also abundant in the tropical seas; and many species, hitherto included in the genus Labrus, ought to be placed here. [Several species of this subgenus occur in the British seas, the chief of which are—*Cranilabrus tinca*, the Gilt-head; *C. corneticus*, the Gold-sinny; *C. gibbus*, the Gibbous Wrasse; and *C. leusias*, the Scale-rayed Wrasse; but they are all small fishes, in little or no estimation.]

Coricus. This subgenus has all the characters of the last, in addition to which the mouth is little less protractile than in the next. Only one small species is known, which inhabits the Mediterranean. This genus is removed from Sparus, in order to be placed near the preceding ones.

Epibulus. These fishes are remarkable for the extreme extension which they can give to their mouth by means of a see-saw motion of their maxillaries, and the sliding forward of the intermaxillaries, which instantly forms a kind of tube. They make use of this artifice for seizing small fishes which pass near this curious instrument; and the same artifice is resorted to by the Coryci, the Zei, and the Smares, according to the degree of protractility of the mouth. The entire body and head of this subgenus are covered with large scales, the last track of which advances upon the anal and caudal fins, as in Cheilinus. The lateral line is similarly interrupted as in the latter; and, as in Labrus, there are two long conical teeth in the front of each jaw, followed by smaller blunt ones. The known species is from the Indian seas, and is of a reddish colour.

Clepticus. This subgenus has a small cylindrical snout, which is suddenly advanced forward, but which is not so long as the head. The teeth are small, and barely perceptible to the touch; the body is oblong; the lateral line continuous; and the dorsal and anal are enveloped in scales nearly to the top of the spines. One species, of a red colour, and from the West Indies, is the only one known.

Gomphosus. These Labridæ, with the head entirely smooth, as in Julis, have the muzzle in the form of a tube, composed of the prolonged maxillaries and intermaxillaries, as far as the small opening of the mouth. Several species are taken in the Indian Ocean, and the flesh of some is considered delicious.

Xirichthys, resemble Labrus in their general form, but are much compressed. The forehead descends towards the mouth with a sharp and almost vertical line, formed by the ethmoid and the ascending branches of the intermaxillaries. Their bodies have large scales; their lateral line is interrupted; their jaws are furnished with conical

teeth, largest in the centre; the pharynx is paved with hemispherical teeth; the intestinal canal has two flexures but no cœca; the stomach has no cul-de-sac, and they have a tolerably long air-bladder. [Until Cuvier arranged them differently, they were always classed with the Coryphenes, from which they differ much, both externally and internally.] They most nearly resemble Labrus, and are not easily distinguished from it, except by the profile of the head. Are found in the Mediterranean, and also in the southern seas; and the flesh of some is much esteemed.

Chromis. These have the lips, protractile maxillaries, pharyngeals, and general aspect of Labrus; but their teeth resemble those of a card, except a range of conical ones in front. Their dorsal fins have long filaments; their ventrals are produced into long threads; their lateral line is interrupted; and their stomach forms a cul-de-sac, but has no cœca. A small one, of a chestnut-brown colour, is taken in vast numbers in the Mediterranean; and there is one in the Nile, *C. niloticus*, the Egyptian *Corycina* of the ancients, which attains the length of two feet, and is reckoned the best fish in Egypt.

Cychla, have the teeth small and crowded, formed into a large band, and the body elongated, which are their chief differences from the preceding subgenus.

Plesiops, have the head compressed, the eyes near each other, and extremely long ventrals; but in other respects they resemble Chromis.

Malacanthus. These have the general character of Labrus, and the same teeth in the maxillaries, but their teeth in the pharynx are arranged like those of a card. Their bodies are elongated, their lateral line continuous, their operculum terminated by a small spine, and their long dorsal has only a few flexible spinous rays in the fleshy part. A species is found in the West Indies, of a yellowish colour, irregularly streaked across with violet, which, like many others belonging to this family, has been improperly ranged with the Coryphenes.

Scarus.— The fishes of this genus are remarkable for their jaws—that is to say, for their intermaxillaries and premandibles,—which are convex, rounded, and furnished with scale-like teeth on their margin and anterior surface. These teeth succeed each other from the rear to the front in such a manner that the bases of the newest form a trenchant range. It has been erroneously supposed by naturalists that the bone in this state is naked. In the living state, the jaws are covered with fleshy lips, but there is no double lip adhering to the suborbital bones. These fishes have the oblong form of Labrus, with large scales, and an interrupted lateral line. They have two plates in the upper part of their pharynx, and one in the under, furnished with teeth as in Labrus; but their teeth are in transverse laminæ, and not rounded and arranged like the stones of a pavement.

The Archipelago contains one species, of a blue or red colour, according to the season, which is the *S. creticus* of Aldrovandus; and which, after new investigations, I believe is the true Scarus so celebrated among the ancients, which, during the reign of Claudius, Elipertius Optatus the Roman admiral sailed to Greece in order to obtain and distribute through the Italian seas. It is still eaten in Greece, and its intestines are used for seasoning. There are numerous species in the tropical seas, which, on account of the form of their jaws and the brilliancy of their colours, are called Parrot-fishes. Some have the caudal fin in the shape of a crescent; and of these a few have the front singularly enlarged and rounded, while in others it is truncated to a square. These constitute the genus Scarus, properly so called, from which two subgenera may be separated:—*Calliodon*, which have the lateral teeth of the upper jaw separate and pointed, and on the same jaw an anterior range, much smaller in size; and *Odax*, which resemble the true Labrus in their thickened lips and uninterrupted lateral line, but their jaws are constructed as in Scarus, except that the bones are flat, not rounded, and are covered by the lips. Their teeth, however, resemble pavement, like those of Labrus.

THE FIFTEENTH FAMILY OF THE ACANTHOPTERYGII.

FISTULARIDÆ (Pipe-mouthed Fishes).

The fishes of this family are characterized by a long tube projected forwards from the cranium, and composed of elongations of the ethmoid, vomer, pre-operculum, inter-operculum, pterygoids, and tympanals, at the extremity of which they have the mouth, composed, as usual, of intermaxillaries, maxillaries, palatals, and mandibles. Their intestine has no great inequalities, nor many flexures; and their ribs are short, or wanting. The family consists of two genera:—*Fistularia*, with the bodies cylindrical; and *Centriscus*, in which it is oval and compressed.

Fistularia. Fishes of this genus receive their particular name from the long tube common to all the family. Their jaws are at its extremity, but little cleft, and opening nearly in a horizontal direction. Their head, thus elongated, is equal to a third or a fourth of the length of the body, which is itself long and slender. There are six or seven rays in their gills; and some osseous appendages extending behind the head, by means of which the anterior part of the body is more or less strengthened. The dorsal is directly above the anal; and the stomach is a fleshy tube extending in a straight canal, but with two cœca at the commencement. There are two subgenera.

Fistularia, Pipe-mouths, properly so called. These have only one dorsal, consisting, in great part, as well as the anal, of simple rays. Their intermaxillaries and the lower jaw are furnished with small teeth. From between the lobes of the caudal fin there arises a sort of filament, which is sometimes as long as the body. The tube of the muzzle is depressed; the air-bladder is exceedingly small; and the scales on the skin are invisible. They are found in the warm seas of both hemispheres. [Sailors term them Tobacco-pipe Fishes, and they are of no value, except as curiosities.]

Aulostomus. These have numerous free spines before the dorsal; and their jaws are toothless: their body is very scaly; not so slender as in the former subgenus, but enlarged and compressed between the dorsal and the anal, which enlargement is followed by a short and slender tail, ending in a common fin. The tube of the muzzle is shorter, wider, and much more compressed than that of the true Pipe Fishes; and the air-bladder is larger. There is but a single known species, which is a native of the Indian Ocean.

Centriscus, or Snipe-fish.—These have the tubular muzzle characteristic of the family; but the body is oval or oblong, not lengthened, compressed laterally, and sharp on the upper part. They have only two or three slender gill-rays; a spinous first dorsal; and small ventrals behind the pectorals. Their mouth is very small, and opens obliquely: their intestine has two or three folds, but no cœca: and their air-bladder is of considerable size. As in Fistularia, they admit of division into two subgenera.

Centriscus, properly so called. These have the first dorsal fin backwards; and the first dorsal spine, which is long and strong, connected, by intermediate pieces, with the bones of the shoulder and the head. They have the body covered with small scales, and some larger denticulated ones over the apparatus connected with the spinous ray of the first dorsal. [This ray is strong in itself, firmly supported, and with rugged teeth on its posterior edge, capable of being moved, and thus forms a very powerful weapon. One species, *C. scolopax*, the Sea Snipe, Sea Trumpet, or Bellows Fish of the Cornish coast, is common in the Mediterranean, and is occasionally found on the south coast as a straggler. The specimens met with are not large, not exceeding five or six inches in length. The young are of a brilliant silvery lustre; but when mature, the back is red, paler on the sides, and passing into silvery, glossed with gold, on the belly. All the fins are greyish white. The scales are hard and rough, granulated on the surface, and beautifully ciliated on the posterior edge. Its flesh is considered good. Its haunts are understood to be muddy bottoms, in moderately deep water; and its food the minute Crustacea with which such places usually abound.]

Amphisile, has the back mailed with large scaly pieces, of which the anterior spine of the first dorsal appears to be a continuation. Some have other scaly pieces on the flanks, and the spine in question placed so far behind that it is against the base of the tail; against which it, as it were, thrusts the second dorsal and the anal; this is *C. scutatus*. Others are intermediate between this form and that of the ordinary Centriscus, or have the mail plates covering only a part of the back; such is *C. velitaris*. All the known species are inhabitants of the Indian seas.

THE SECOND ORDER OF BONY FISHES.

MALACOPTERYGII ABDOMINALES.

The second division of the Ordinary Fishes, [or fishes with bones in the skeleton,] the *Malacopterygii*, or Jointed-fin Fishes, consists of three orders, the distinguishing character of each of which is the position or absence of the ventral fins.

The present order comprises fishes which have the ventral fins suspended to the abdomen, behind the pectorals, without being attached to the bones of the shoulder; they are the most numerous order of the division, and include the greater part of fresh-water fishes. They are divided into five families.

THE FIRST FAMILY OF THE MALACOPTERYGII ABDOMINALES.

CYPRINIDÆ (the CARP Family).

These have the mouth shallow, the jaws feeble, very often without teeth, and the margin formed by the outer maxillaries; but they have the pharynx strongly toothed, which compensates for the feeble armature of the jaws. They have few gill-rays; their body is scaly; and they have no adipose dorsal, as we shall find in the Silures and Salmon. The stomach has no cul-de-sac or cœcal appendages; and they are the least carnivorous of all fishes. [The genera and subgenera are arranged as follows:]—

Cyprinus.—These form a genus, at once very natural and very numerous; easily distinguished by the small mouth, the jaws without a single tooth, and three flat gill-rays. Their tongue is smooth; their palate furnished with a thick, soft, and remarkably sentient substance, vulgarly called carp's tongue. Their pharynx is a powerful instrument of mastication, having strong teeth on the inferior pharyngeal bones, and they bruise their aliments between these and a stony disc, which is set in a large cavity under a process of the sphenoid. They have but one dorsal; their body is covered with scales, usually large: they inhabit the fresh waters; and are the least carnivorous of fishes,—feeding chiefly on seeds, the roots of plants, and [as is said] on mud and sludge. The stomach is continuous, with a short intestine without cœca; and the air-bladder is divided in two by a close contraction. The genus is divided into the following subgenera:—

Cyprinus, the true Carps, have a long dorsal, of which, as well as the anal, the second ray has a spine more or less stout. Some of them have fleshy tubercles at the angles of the upper jaw, such as *C. carpio,* the Common Carp, a well-known fish: olive green above, and yellowish below; with strong toothed spines in the dorsal and anal, and short tubercles. The teeth of the pharynx are flat and striated in their crowns, [something like those of the Ruminant Mammalia]. Originally [as is understood] from the middle latitudes of Europe, it is now generally distributed, and thrives well in fish-ponds and other still waters, where it sometimes grows to the length of four feet: its flesh is esteemed as food. [Though an imported fish, Carp thrives well in England, though better in ponds than even in the most slow running parts of rivers; but in Scotland the waters are less adapted for them, and they breed and grow slowly, even in ponds. Austria and Prussia are the great Carp countries. To their vegetable food they add insects and worms, if such can be obtained: and when out of the water, they are very tenacious of life, in consequence of which they are easily extended from pond to pond.]

Of the true Carps there is one race, *C. rex carporum,* the King of the Carps, which have the scales large, but often wanting in patches, and sometimes entirely. They are artificially varied,—that is, they occur only in ponds. Some foreign species are reddish brown, and others golden green, but these are imperfectly known.

Some species want the barbules. Among these are,—*C. carassius,* having the body high, the lateral line straight, and the caudal fin squared off. This is a northern species. *C. gibelio,* the Crucian or Prussian Carp, has the body less elevated, the lateral line curved downwards, and tail fin forked. [It occurs as a British fish, but, perhaps, not so plentifully as the former]. *C. auratus,* the Golden Carp, [called Gold Fishes or Silver Fishes, according to their colour]. These are black when young, but by degrees acquire the golden red for which they are esteemed; though some of them are silvery, with various clouds of all the three colours. Some have no dorsal; others a very small one; others, again, a large caudal of three or four lobes; and others, still, very large eyes; all of which varieties are merely accidental, and the results of that artificial treatment which they receive when kept in glass vessels for ornamental purposes.

Allied to these is the smallest of the European Carps, *C. amarus,* only about an inch in length; greenish above, pale yellow beneath, with a steel-blue line on each side of the tail, in April, which is the spawning season.

Barbus, the Barbel, or Bearded Fish—from the cirri at its mouth—has the dorsal and anal short; a strong spine for the second or third dorsal ray; two cirri at the point of the muzzle, and two at the angles of the upper jaw. [*B. communis,*] the Common Barbel, known by its long head, is very common in streams and fish-ponds, and sometimes grows to the length of ten feet. [In the sluggish parts of the Thames, and some of its affluents, Barbel are very plentiful. They are said to plough up the mud with their noses, which, setting very small animals adrift in the water, attracts those small fishes on which the Barbel feeds.]

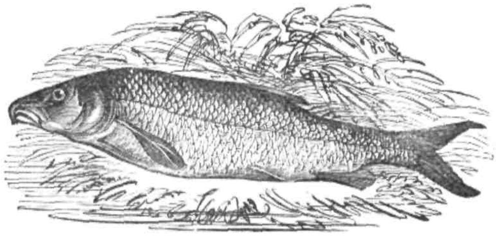

Fig. 142.—The Barbel.

Gobio, the Gudgeons, have the dorsal and anal short, and are without spines or beards. In slow-running rivers, where there is a gravelly interruption, they are found in vast shoals, readily caught, and, though small in size, esteemed for their flavour.

Tinca, the Tenches, resembling the Gudgeons, but have the scales and cirri very small. The Common Tench is short and thick, of a yellowish brown, and sometimes beautifully golden. It prefers stagnant waters, and is not in much estimation as food.

Cirrhinus, have the dorsal larger than the Gudgeons, and the cirri in the central part of the upper lip.

Abramis, Bream, have neither spines nor cirri; a short dorsal behind the ventrals, or long anal; and the tail forked. There are two species, the Carp Bream, and the White Bream; the first is the largest and most highly esteemed; and the other is of little value, except to feed other fishes in ponds.

Labeo. All foreigners; have neither spines nor cirri along the dorsal, and remarkably thick lips, often furred.

Catostomus, have the lips of the former, but a short dorsal above the ventrals. They are from North America.

Leuciscus: dorsal and anal short; no spines, cirri, or peculiarities of the lips: species numerous, but little esteemed. [One species, the Ide, *L. idus,* has been seen as a British fish; and besides this there are several others, as *L. dobulus,* the Double Roach; *L. utilis,* the Roach; *L. vulgaris; L. Lancasteriensis,* the Graining;

L. cephalus; L. erythropthalmus, the Red Eye; *L. cæruleus*, the Azurine; *L. alburnus*, the Bleak; and *L. phoxinus*, the Minnow; but none of them are fishes of any great importance, except as bait for more valuable ones.]

Gonorhynhus, have the head and body elongated, the operculum covered with small scales, the muzzle angular, the small mouth without teeth or cirri, three gill-rays, and a small dorsal over the ventrals. Known only in Southern Africa.

Cobitis, Loche, or Loach, have the head small; the body long, covered with small scales, and slimy; the ventral fins are far backwards, and above them there is a single dorsal; the mouth is at the end of the muzzle, little cleft, and without teeth, but having lips forming a sucker, and numerous barbules; the gills have small openings, and only three rays; the lower bones of the pharynx are strongly toothed; no cœca to their intestines, and these are very small; their two-lobed air-bladder is inclosed in a case of bone, adhering to the third and fourth vertebræ. There are three species in the fresh waters of Europe. *C. barbatula*, the Common Loach, or Beardie, is a little fish of four or five inches long, clouded, dotted with brown on a yellow ground, and having six barbules at the mouth. It is not uncommon in the shallow and clear-running streams; but on account of its lurking habits, the rapidity of its swimming when disturbed, and its small size, it is not often seen. Small as it is, its flesh is very good. *C. fossilis*, the Pond Loach, is sometimes a foot long, with longitudinal stripes of brown and yellow, and ten barbules to the mouth. They inhabit the mud of stagnant waters; and can subsist for a long time after the water has been dried up, or covered with ice. When the weather is stormy, they rise to the surface of the water, and keep it in a state of agitation by their motion; and when cold, they bury themselves in the mud. Ehrman states that they habitually swallow atmospheric air, which is discharged by the vent, after being changed into carbonic acid,—[a fact which is contrary to the usual physiology of the class]. Their flesh is soft, and has a muddy flavour. *C. tænia*, the Groundling, has six barbules, and the body compressed, of an orange colour, marked with a row of black spots. It has a large spine behind each nostril. It is the smallest of the species inhabiting the smaller running waters, and lurking under stones. [It is found in the British rivers, and is probably much more numerous than is generally represented; but as it is of no value, it is regarded only by naturalists.]

Anableps. This genus, long, but very improperly, united with Cobitis, has strong peculiar characters. The eyes are prominent, placed under a sort of roof formed by the side of the frontal; and the cornea and iris are divided by transverse bands, which gives the fish the appearance of having four eyes, whereas in reality it has only two. There are certainly two openings to each eye, but still, in its essential parts, the organ is single; and whether vision is performed by the anterior or posterior opening, the same sentient organ is acted upon. They have also the generative and urinal aperture, in the male, placed before the vent; and the female brings forth her young alive, and in a state of considerable advancement. The body is cylindrical, with strong scales; there are five gill-rays; the head is flat; the snout blunt, and the mouth across its extremity, with small crowded teeth in both jaws; the intermaxillaries have no peduncle, but are suspended to the nasal bones; the pectorals are in part scaly; the dorsal is small, and nearer the tail than the anal; the pharyngals are large, and covered with small globular teeth; the air-bladder is large; and their intestine is wide, but without any cœca. Only one species, *A. tetropthalmus*, the Four-eyed, is known. It inhabits the rivers of Guiana.

Pœcilia. These have the jaws horizontally flattened, with a small opening, and furnished with a single row of small and very fine teeth; the upper part of the head flat; the gill-openings large, with five gill-rays; the body rather short; the ventrals rather forward; and the dorsal and anal against each other. They are small fishes of the fresh waters of America, and bring forth their young alive.

Labias, resemble the preceding, only the teeth have several points. One species, a very small fish, with little black streaks on the flanks, is found in Sardinia.

Fungulus, still resemble Pœcilia, but their teeth are set like velvet: those in the anterior range are crooked, and they have strong conical ones in the pharynx. They have only four gill-rays.

Molenesia, have the anal between the ventrals, and immediately under the anterior part of the large dorsal; teeth like Fungulus, and four or five gill-rays. [These genera are chiefly found in America.]

Cyprinodon, have fine velvety teeth, and six gill-rays, but in other respects are like the preceding genera. *C. umbra* inhabits the lakes, and especially the subterranean waters which are so common in Southern Austria. They are small fishes, of a russet colour, with brown spots.

THE SECOND FAMILY OF THE MALACOPTERYGII ABDOMINALES.

ESOCIDÆ (the PIKE Family).

These have no adipose dorsal fin. The margin of the upper jaw is formed by the intermaxillary; or when not so formed, the maxillary is toothless, and concealed by the lips. These fishes are extremely voracious; their intestine is short, and has no cœca; all of them have an air-bladder. Many species inhabit the fresh waters, or ascend rivers. With the exception of *Microstoma*, all the known ones have the dorsal opposite the anal. Linnæus included them all in the genus *Esox*, but we divide that genus into the following subgenera:—

Esox, Pikes properly so called, have small intermaxillaries, furnished with small pointed teeth in the middle of the upper jaw, where they form two rows, but the lateral parts of the maxillaries are without teeth. The vomer, the palatals, the tongue, the pharynx, and the gill-arches, are roughened with teeth like a card; and they have, in

the sides of the under-jaw, a row of long and pointed teeth. The muzzle is oblong, obtuse, broad, and depressed. They have but one dorsal placed over the anal; a large forward stomach, continued in a slender intestine with two flexures, but without cœca; and their air-bladder is very large.

E. lucius, the Common Pike, Jack, Pickarel, Gedd, and many other names, is well known to every one as the most voracious and destructive of fishes, but its flesh is good, and easy of digestion. [Besides its fame, as an eater and as being eaten, Shakspeare has thrown a ray of glory around the Pike by representing it as the "White Lucie" in the armorial bearings of the immortal Justice Shallow. In some of the still waters of Britain, Pike of thirty-four pounds' weight have been killed. It is generally said that, notwithstanding the havoc which the Pike commits among smaller fishes, it will not stand the attack of a Trout of equal weight, the immense velocity of the latter fish in swimming giving it a decided advantage]. Besides this, two species have been noticed in the fresh waters of North America,—*E. reticularis*, with a net-work of brownish lines; and *E. estor*, sprinkled with round blackish spots.

Galaxius, have no visible scales on the body. The opening of the mouth is small, with middle-sized pointed teeth in both jaws, the margin of the upper being formed by the intermaxillary, and a few strong crooked teeth on the tongue. There are pores in the sides of the head; and the position of the dorsal and anal fins, and also the digestive organs, are like those of the Pikes.

Alepocephalus. Head naked, body with broad scales, mouth small, teeth minute and crowded, eyes very large, and eight gill-rays. *A. rostratus*, the only known species, is found in the depths of the Mediterranean.

Microstoma. Snout very short, lower jaw beyond the upper, jaws and intermaxillaries with very small teeth, three broad and flat gill-rays, eyes large, body long, lateral line with firm scales, a single dorsal a little in rear of the ventrals, and digestive organs as in the Pike. The only known species (*S. microstoma* of Risso) inhabits the Mediterranean.

Stomias. Snout extremely short, mouth cleft almost to the gills, gill-ray reduced to a little membranous lamina, and maxillaries fixed in the cheek; intermaxillaries, palatals, mandibles, and tongue, armed with long and crooked teeth, widely set; body elongated; ventrals far back; dorsal over the anal, and both near the caudal. Two species were discovered in the Mediterranean by Risso. Both are black, with rows of silvery spots on the belly. *E. boa*, Risso, has no cirri; *S. barbatus*, has a long and stout one, attached to the symphisis of the lower jaw.

Chauliodus, resemble the former, but have two teeth in each jaw, across the other jaw when the mouth is shut; the dorsal between the pectorals and ventrals, which last are not so far back as in Stomias; the first dorsal ray terminates in a filament. *C. Sloani*, the only known species, has been found only at Gibraltar. It is about a foot and a half long, and of a deep green colour.

Salanx, have the head depressed, gill-lids folded downwards, and four flat gill-rays; the jaws short and pointed, each furnished with a row of crooked teeth; the upper jaw formed entirely by intermaxillaries without peduncles; the lower jaw is a little lengthened at the symphisis by a small appendage carrying the teeth; the palate and the inner part of the mouth are entirely smooth, and there is not even a lingual projection.

Belone. This genus have the upper jaw—which, as well as the under one, is extended into a long beak—composed of the intermaxillaries, and both jaws furnished with small teeth, without any others in the mouth, except in the pharynx, where they are arranged like a pavement. The body is very long, and covered with scales which are scarcely visible, except one keeled row on each side, near the under edge of the fish. They are remarkable for the bright green colour of their bones. One species—the Common Gar-fish, Sea Pike, Mackerel Guide, Green-bone, and a number of other names—is not uncommon on some parts of the British shores, and as far north as the Arctic regions. It is of a greenish blue on the upper part, fading gradually into silvery white on the belly. There are several other species, some of which are said to attain the length of eight feet, and bite very severely. Notwithstanding the colour of the bones, which renders them repulsive to many persons, the flesh of these fishes is not unwholesome.

Scomberesox, the Mackerel Pike, or Saury Pike, resembles the former in the length of its snout, its general shape, and its scales; but the last rays of the dorsal and anal are detached, and form spurious fins on the upper and under sides, like those of the Mackerel. They are found in the Mediterranean; [and the Common Saury is generally distributed along the British coasts, as far to the northward as the Orkneys]. They are gregarious fishes; and are followed and preyed upon by Porpoises, and also by the Tunny, and other large members of the Mackerel family.

Hemiramphus, resembles the Gar-fish in its general characters, but has the upper jaw short, and the lower one drawn out into a long beak, without teeth. They are found chiefly in the seas of warm countries, though a stray one is occasionally met with in the south of England.

Exocetus, [literally, "Fishes out of the water"]. These are at once distinguished from all the rest of the Abdominal Malacopterygii by the immense size of their pectoral fins, which are sufficiently large for supporting them for a few moments in the air. Their head and body are scaly, with a line of keeled scales along each flank; their head is flat above, and laterally; the dorsal over the anal; the eye is large; the intermaxillaries without peduncles, and found in the margin of the upper jaw; both jaws have small pointed teeth, and the pharynx pavement teeth; they have ten gill-rays; their air-bladder is very large; their intestine straight, and without cœca; and the lower lobe of the caudal fin much larger than the upper. They do not fly, in the strict sense of the term, but merely rise from the water to escape voracious fishes, and soon fall again,—their fins merely serving as parachutes, and being incapable of taking a new stroke in the air, as is done by a wing. They are found in all the seas of the warm climates; and it would seem that they have more enemies than most other fishes, for while the voracious fishes pursue and capture them in the water, the long-winged sea-birds seize them in the air; and between themselves

and their swimming and flying enemies, they furnish one of the most singular sights in the warm seas. *E. exilens*, common in the Mediterranean, has the ventral fins long, and in rear of the middle of the body. *E. volitans*, common in the Atlantic, has the ventral fins small, and placed further forwards. The latter species sometimes visits the British shores, in single individuals, and even in shoals. They can leap more than two hundred yards in distance, and upwards of twenty feet in height. Their food is understood to be the small floating Mollusca; and themselves are good eating.

Next to the Pike family, there is placed a genus of fishes which, though differing but little from that family in other respects, has longer intestines, and two cœca. It will probably give rise to a new family. This is *Mormyrus*, having the body compressed, oblong, and scaly; tail thin at the base, but swelling near the fin; skin of the head naked, covering the operculum and gill-rays, and leaving no opening for the latter but a vertical fissure, which has led some naturalists to assert that these fishes have no gill-lids, and only one gill-ray, whereas their gill-lids are perfect, and their rays five or six. Their gape is small, and resembles that of the Ant-eater, the angles being formed by the maxillaries. The teeth are small, notched at the extremities, and occupy the intermaxillaries and lower jaw; and there are bands of small crowded ones on the vomer and tongue. The stomach is a roundish sac, followed by a slender intestine with two cœca, almost always covered with fat; and the air-bladder is long, large, and simple. They are accounted among the best fishes of the Nile. Two species have a cylindrical muzzle,—the one having a long dorsal, and the other a short one; a third has both the snout and dorsal short; and in a fourth, the forehead forms a protuberance advancing in front of the mouth. There are various other species in the Nile [and probably also in the other African rivers], but they have not been described.

THE THIRD FAMILY OF THE MALACOPTERYGII ABDOMINALES.

SILURIDÆ (the SHEAT-FISH Family.)

These fishes are distinguished from all the rest of the order by the want of true scales, having only a naked skin, or large bony plates. The intermaxillaries, suspended under the ethmoid, form the margin of the upper jaw; and the maxillary bones are either simple vestiges, or extended into cirri. The intestinal canal is large, folded, and without cœca. The air-bladder is large, and adheres to a peculiar apparatus of bones. A strong articulated spine generally forms the first ray of the dorsal and the pectorals; and there is sometimes an adipose dorsal behind the other, as in the Salmon family. The following are the genera and subgenera:—

Silurus.—These form a numerous genus, known by the naked skin, from the mouth being cleft in the end of the muzzle, and from a strong spine in the first ray of the dorsal. This spine is articulated only to the bones of the shoulder; and the fish can at pleasure lay it flat on the body, or keep it fixed in a perpendicular direction, in which case it is a formidable weapon, and wounds inflicted by it are understood to be poisoned, which opinion has arisen from tetanus sometimes following the wound, not from poison certainly, but from the ragged nature of the wound itself.

These fishes have the head depressed; the intermaxillaries suspended under the ethmoid, and not protractile; the maxillaries very small, but almost always continued in barbules attached to the lower lip, and also to the nostrils; the covering of their gills is without sub-operculum or gill-flap; their air-bladder, strong and heart-shaped, is attached, by its two upper lobes, to a peculiar bony structure, which again is attached to the first vertebra; the stomach is a fleshy cul-de-sac, having the intestinal canal long and wide, but without cœca. They abound in the rivers of warm countries; and seeds of plants are found in the stomach of many of their species. The following are the subgenera:—

Silurus, properly so called, with only a small fin of four rays on the fore part of the back, but with the anal very long, and approaching very close to the base of the caudal. There is no obvious spine in the dorsal; and the teeth in both jaws, and in the vomer, are like those of a card. *S. glanis*, the Sly Silurus, is the largest fresh-water fish of Europe, and the only member of the genus in this quarter of the world. It is smooth, of a greenish black spotted with black above, and yellowish white below; head large, with six cirri,—two large ones near the nostrils, and four shorter on the lower jaw. It sometimes grows to six feet in length, and weighs three hundred pounds. It is found in the slow-running rivers of Central Europe, and lurks in the mud to watch for its prey. Its flesh is greasy, and is sometimes employed as hog's-lard. [It is named as a British fish, but its visits to these shores are very rare.] Is found in the rivers of Asia and Africa.

Schilbus, have the body vertically compressed, a strong toothed spine in the dorsal, the head small and depressed, the nape suddenly raised, and the eyes low down. They have eight cirri, are found in the Nile, and their flesh is

less disagreeable than that of the other Siluri. Some American species, with the head small, rounded, and blunt, having three cirri, and the eyes scarcely perceptible, may form a new subgenus.

Mystus, are Siluri with a second or adipose dorsal fin. They are found in the waters of Guiana.

Pimelodes, body naked, and no lateral armature; but the subgenus requires division and subdivision. First, *Bagrus* has small crowded teeth in both jaws and the vomer, and may be subdivided by the number of cirri, and the shape of the head. With eight cirri, some have the head long and depressed, and others short and broad. With six cirri, some have the snout as depressed, and broader than that of the Pike; others have the head oval, and a kind of helmet of shagreen-like bones; in others, the head is round and naked; while others, again, have the head greatly depressed, the eyes low down, and the adipose fin very small; and there are yet others which have only four cirri. [Some of these, as *Pimelodes cyclopum*, are ejected in hot water from volcanoes.]

Pimelodes, properly so called, want the teeth in the vomer, but often have them in the palate; the cirri and form of the head differ more than in the preceding subgenus; some have but a single row of teeth; some have the head helmeted, and a distinct bony plate between the helmet and the dorsal spine; others have a single plate from the snout to the dorsal; others, again, have the head oval and naked; some with six cirri, and others eight; some with a large naked head are called Cats, which have six or eight cirri; then there are others which have the head small and flat, the dorsal minute, and the teeth scarcely perceptible; there are others still which have teeth on the palatals, sometimes like velvet, or like a card, with a buckler on the nape, distinct or united to the helmet, and the palatal teeth sometimes like a helmet; some singular ones have teeth like a card, under the skin of the cheek, and moveable; others yet have a lengthened snout, or a pointed one, nearly toothless. These last lead to,—

Synodontis, with the snout narrow, and the lower jaw supporting an assemblage of teeth laterally flattened, ending in hooks, and individually attached to flexible peduncles. The helmet extends in one plate to the first spine of the dorsal, which is very strong, as are also those of the pectorals; the cirri, and sometimes the maxillaries, are barbed. They are found in the Nile and other African rivers, but are not eaten.

Ageniosus. Some of these have the maxillary turned up in a kind of toothed horn, instead of a fleshy cirrus; and others have it concealed under the skin, with the dorsal and pectoral spines scarcely visible.

Doras, have an adipose dorsal, with plates in the lateral line, armed with keels or spines; the dorsal and pectoral spines strongly toothed, the helmet rough, and the shoulder-bone pointed backwards. Some have teeth only in the upper jaw; others have the snout pointed, and the teeth absent, or hardly visible, with occasional lateral bristles to the cirri.

Heterobranchus, head broad, from the helmet having two lateral pieces of the frontal and parietal bones; operculum smaller, but with a tree-like ramification on the third and fourth gill-arch, as a sort of supplemental gills; viscera like the rest of the family, but they have from eight to fourteen gill-rays, strong pectoral spines, no dorsal one, and the body long and naked. They inhabit the rivers of Africa, and some of those of Asia. Their flesh is indifferent, or bad.

One of them, however, *Macropteronotes*, with a single indented dorsal, constitutes a considerable article of food in Egypt and Syria, where it is called the Sharmuth, or Black Fish. Others have a dorsal with rays, and also an adipose one. *Protosus*, have a second dorsal, with rays; and this and the anal long, and uniting to form a tail like an Eel; lips fleshy; conical teeth in front of the mouth, globular ones behind, and those above placed on the vomer; skin naked; nine or ten gill-rays; eight cirri; and a singular branched appendage behind the vent, besides the tubercle common to the family. Some have large and toothed dorsal and ventral spines; others have them almost concealed under the skin. They are found in the East Indies.

Callichthys, have the sides armed with four rows of scaly plates; head the same, but the snout and under-part of the body naked; one ray in the second dorsal; pectoral spines strong, and dorsal one feeble; mouth small; teeth barely visible; four cirri; eyes small, and lateral. They can crawl out of the water like an Eel. [These are the subgenera of Silurus].

Malaptherurus, has no dorsals with rays, but only a small adipose one in the tail, and no spines in the pectorals. The skin is smooth; the teeth small and crowded, and are ranged into a broad crescent in each jaw; there are seven gill-rays; and the jaws and viscera are like those of Silurus. *M. electricus*, the Raasch, or Thunder-fish of the Arabs, is the only known species. It has six cirri, and the head more slender than the body, but enlarged in front. Like the Torpedo and Gymnotus, it can communicate an electric shock, the organ of which is situated between the skin and muscles, and consists of a cellular tissue, inclosing a fluid, and abundantly furnished with nerves. It is found in the Nile, and the rivers of Central Africa.

Aspredo, have the head flattened, and the anterior part of the body much widened; the tail long; the eyes small, and placed upwards; the intermaxillaries under the ethmoid directed backwards, and with teeth on the posterior edge only; and they have the whole gill apparatus immoveable, being soldered to the temporal bone and the preoperculum; gill-opening a mere slit behind the head, the membrane of five rays adhering everywhere else; the lower jaw is transverse, and shorter than the snout; the first ray of the pectorals is more toothed than in any other of the family; there is but one dorsal, with a weak first ray; but the anal is long, extending under the long and slender tail. Some have six cirri, some eight; and, in the latter case, one pair are attached to the maxillaries, the others to the lower jaw in pairs.

Loricaria, have hard angular plates on the head and body; small intermaxillaries suspended under the muzzle; transverse disunited mandibles, supporting hooked teeth, which are long, slender, and flexible. A large membranous veil encircles the opening; the pharynx is furnished with numerous pavement teeth; the gill-lids are immoveable, but two small plates supply their places; they have four

gill-rays; strong spines in the first dorsal, pectorals, and even ventrals; but neither cœca nor air-bladder They form two subgenera :—

Hypostomus, have a small dorsal with one ray; the labial veiled with papillæ, with a small cirrus on each side, no plates on the belly; and the intestines spirally convoluted, and as slender as a thread. They inhabit the rivers of South America.

Loricaria, have one dorsal forwards, the labial veiled with cirri, plates on the under parts of the body, and the intestines moderately large.

THE FOURTH FAMILY OF THE MALACOPTERYGII ABDOMINALES.

SALMONIDÆ (the SALMON, or TROUT, Family).

According to Linnæus, these formed but one great genus, characterized by a scaly body, all the rays of the first dorsal soft, and the second dorsal adipose, or formed of skin inclosing fat, and without rays. They have numerous cœca, and an air-bladder. Most of them ascend rivers; and their flesh is highly esteemed. They are naturally voracious; and as the form and armature of their jaws vary greatly, they may be arranged into the following subgenera :—

Salmo, Salmon and Trout, properly so called.—These have great part of the margin of the upper jaw formed of the maxillaries; a row of pointed teeth in the maxillaries, the intermaxillaries, the palatals, and mandibularies, and two rows on the vomer, the tongue, and the pharynx,—being, in fact, the most completely toothed of all fishes In old males, the extremity of the lower jaw is bent up towards the palate, where a groove receives it when the mouth is shut. The ventrals are under the first dorsal, and the anals under the adipose one. They have six gill-rays, or thereabouts; the stomach is long and narrow, with numerous cœca; their air-bladder extends the whole length of the abdomen, and communicates anteriorly with the gullet. Many species are spotted, and their flesh is in general very good. They ascend rivers to spawn, often leaping over cascades of considerable elevation, and finding their way to the brooks and small lakes of the most lofty mountains. [They are understood to return almost invariably to the rivers in which they are produced; and therefore the fixing, at the mouth of a river, of any sort of bar to their progress upwards, is sure to drive them from the estuary. According to Mr. Yarrell, one of the very best authorities, all the family are clouded with transverse dusky patches when very young,—analogous to what occur on all the species of Cats.]

S. salar, the Salmon properly so called, is the largest of the genus, with red flesh, and irregular brown spots, which disappear in fresh water; the cartilaginous beak of the male is not much hooked. They inhabit the seas of comparatively cold regions, whence they ascend the rivers for the purpose of spawning, at different times of the year according to the climate,—some in autumn, some in winter, and some in early spring. [The efforts which they make to overcome difficulties in the ascent are very great; and when they have made some progress up the fresh water, it is equally cruel and impolitic to capture them. It should seem that, in most of the British rivers, Salmon are diminishing in numbers, and becoming inferior in quality, the cause of which has not been explained in a satisfactory manner. In Ireland, where they have more recently become an article of commerce, they are found in considerable abundance. Salmon Fry have the tail forked, and the fork disappears as the fish advances in age; but the margin does not become convex, as in the Bull-trout.] *S. humatus*, is whitish, spotted with red and black; and the snout of the male is narrow, and much crooked in the lower jaw. Its teeth are more robust than those of the true Salmon, and its flesh as red; but it is inferior in quality. It is found in the mouths of rivers. *S. Schiefermulleri*, the Sea-trout, is smaller than the former, with the teeth more slender and longer. The flanks are sprinkled with small crescent-shaped spots, and the flesh is paler than that of the Salmon. *S. hucho* [perhaps the Bull-trout, or Gray Trout], grows to almost the size of the Salmon, and has strong teeth, and a pointed lower jaw in the male.

The remaining Trouts are found in all the clear streams of Europe, especially among mountains; and they are subject to great variations from age, food, and the nature of the waters; but these do not appear to account for all the differences. [In the same river, Trout are yellowish brown, with bright crimson spots, where the water is fine and pure; and lurid and dark, and greatly inferior in flavour, where it is tinged with peat.] *S. lemanus*, Geneva Trout, found in that lake, and some neighbouring ones; ground colour whitish, with small blackish spots on the head and back; sometimes forty or fifty pounds in weight: the flesh is white. *S. trutta*, Salmon Trout, bluish black above, pale on the sides, silvery on the belly, with cross-shaped spots towards the upper part, migratory in clear streams, and esteemed next in value to the Salmon. [It varies a good deal in colour; and, from its silvery lustre, it is called White Trout in some parts of Britain.] *S. fario*, the Common, or River Trout, is generally smaller than the last, spotted with brown on the back, and crimson on the flanks,—the crimson spots usually surrounded by a pale-coloured circle; common in all the clear streams of temperate countries, and sometimes found two feet and a half long, and fifteen pounds in weight. [The *Gillaroo* Trout of the Irish lakes appears to be a variety, in which the internal coating of the stomach is modified a little to suit the nature of the food. *S. ferox*, the Great Grey Trout, inhabits the deeper lakes, and grows to a large size, but its flesh is inferior.] *S. savelinus*,

the Welsh Char, or Torgoch, has red spots in the flanks, an orange belly, and red pectorals, with the first ray very thick and white. *S. alpinus*, nearly the same colour, but the first rays of the lower fins not so much distinguished. It abounds in Lapland, where it is very valuable. *S. umbla*, Northern Char, found in various British lakes, and also in the Lake of Geneva. [There are various other members of the genus Salmo, but the line of distinction between species and variety is sometimes not easily drawn.]

Osmerus, the Smelt, has two rows of teeth on each palatal, but only a few in front of the vomer. Form like a Trout, but only eight gill-rays, and the body brilliant silvery, with some greenish reflections, but with no spots. [Found abundantly in some estuaries of British rivers at particular seasons, but very local. It seldom exceeds, and rarely equals, a foot in length. Its flesh is delicious.]

Mallotus, mouth like the preceding, but teeth very small and crowded, and only in the jaws, palate, and tongue; eight gill-rays, body lengthened, and small scales; first dorsal and ventrals behind the middle, pectorals large, round, and nearly meeting beneath. The only known species, *S. groenlandicus*, the Capelin, classed by Gmelin among the Herrings, is remarkably abundant on the shores of Newfoundland, and used as bait in the Cod fisheries, [and sometimes as manure for the land].

Thymallus, the Grayling, has the jaws like a Trout, but the mouth small, and the teeth remarkably fine; first dorsal long and high, scales much larger than on a Trout, stomach thick, and seven or eight gill-rays; first dorsal long, as high as the body, spotted with black, and occasionally with red, with dusky bars on the large dorsal. Recent it smells like wild thyme, and when cooked in its perfume it is a dainty dish.

Coregonus, the Gurniad, has the mouth as in the last, but with few teeth, and sometimes none, the scales larger, and the dorsal shorter. There are many species or varieties of this genus; some in the sea, others in the fresh waters only, and one occurs in several British lakes. [*C. Willughbii*, the Vendace, is found in some lakes of the south of Scotland. It feeds on insects, and very minute fresh-water Crustacea.]

Argentina, has the mouth small and toothless, but strong hooked teeth on the tongue, and small ones before the vomer, six gill-rays, and the digestive organs like those of a Trout. *A. sphyræna*, the only known species, has the air-bladder thick, and very much loaded with *nacre*—the silvery substance used in counterfeiting pearls; it is found in the Mediterranean. The following subgenera, which have the numerous cœca of the Salmon, and the double air-bladder of the Carps, have not more than four or five gill-rays.

Crimata, externally like Thymallus, and some of them have the same teeth, differing only in the gill-rays. Others have teeth in both jaws, sharp and directed forwards. They inhabit the American rivers.

Anastomus, like Thymallus, and with small teeth in both jaws, but the lower jaw is so turned up and enlarged at the point, that the mouth appears a vertical slit.

Gastropelecus, mouth as in the last, but abdomen compressed, projecting, and sharp; ventrals small and far back, first dorsal over the anal; upper teeth conical, lower ones notched and trenchant.

Plabucus, have the head small, the mouth shallow, a compressed body, the ventral keel entire and sharp, a long anal, and the first dorsal opposite its commencement.

Serrasalmus, has the body compressed, the belly toothed and sharp, and frequently a spine in front of the dorsal. The known species inhabit the South American rivers; and, it is said, pursue ducks, and even bathers; wounding them severely with their teeth, which are triangular, notched, and very sharp.

Tetragonopterus, has teeth as in the former, but the mouth smaller, and no keel or tooth on the belly.

Chalceus, with the same mouth and teeth, has the body oblong, and the teeth on the maxillaries small and rounded.

Myteles, with triangular teeth hollowed in the crowns, and three points at the corners, mouth shallow, with two rows on the intermaxillaries, but none on the palate, the maxillaries, or the tongue. Some have the elevated form, falchion-shaped fins, spine directed forwards, and even the sharp and toothed belly, of *Serrasalmus*, but not the teeth. One American species grows large, and is good eating. Others have simply an elongated body, and the first dorsal between the ventrals and the anal. These are Egyptian.

Hydrocyon, have the point of the muzzle formed by the intermaxillaries, the maxillaries nearer before the eyes, and completing the aperture; the tongue and vomer are always smooth, but the jaws have conical teeth, and the large suborbital covers the cheek like an operculum. Some have a close range of small teeth on the maxillaries and the palatals, and the dorsal fin between the ventrals and anals. They inhabit the tropical rivers, and taste like Carp. Others have a double row of teeth in the intermaxillaries and lower jaw, a single row in the maxillaries, and none in the palate; the first is over the ventrals. They inhabit Brazil. Others, again, have a single row in the maxillaries and lower jaw, with the teeth alternately very long and very sharp, and lodging in holes of the upper jaw when the mouth is shut; there are large scales upon the lateral line, and the first dorsal is between the ventral and the anal. They are also from Brazil. A fourth type have the muzzle prominent and pointed, the maxillaries very short, and with the lower jaw and intermaxillaries with a single row of closely-set teeth; the first is between the ventral and anal, and they have large scales. They too are from Brazil. Others, yet, have no teeth in the maxillaries or lower jaw, and what they have are few, but strong and pointed; their first dorsal is directly over the ventrals. They inhabit the Nile.

Cetharinus, have the mouth depressed, cleft at the end of the muzzle, and the upper margin entirely formed by the intermaxillaries; the maxillaries are small and toothless, occupying only the commissure; the tongue and palate both smooth, the adipose, dorsal, and great part of the caudal, covered with scales. Found in the Nile. Some have three small teeth in the upper jaw, and the body elevated, but the belly not sharp or toothed. Others have many ranks of close teeth on the jaws, which teeth are slender and forked, and the fishes themselves are elongated.

Saurus, muzzle short, gape cleft far behind the eyes, margin of the upper jaw composed wholly of intermaxil-

laries, long pointed teeth on the jaws, the palatals, and on the tongue and pharynx, but none on the vomer; eight or nine, often twelve or fifteen, gill-rays: the first dorsal a little behind the large ventrals; the body, cheeks, and gill lid are scaly, the intestines like those of Trouts. They are marine fishes, and exceedingly voracious. One is found in the Mediterranean, a transparent one in the lake of Mexico, and several in India, where they are dried and salted as a relish.

Scopelus, have the gape and the gill openings very deep. Both jaws with very small teeth, the margin of the upper formed entirely by the intermaxillaries, the tongue and palate smooth, muzzle very short and blunt, nine or ten gill-rays, a first dorsal between the ventrals and anal, and a second, in which there are slight vestiges of rays. One small species in the Mediterranean has brilliant silver spots on the belly and tail.

Aulopus, combines the characters of Salmon and Cod. Their gape is wide, their intermaxillaries forming the whole margin of the upper jaw; their palatals, the front part of the vomer, and the lower jaw with a band of card-shaped teeth, but the tongue and flat part of the palate are only rough. The maxillaries are large and toothless, as in many fishes, their ventrals are under the pectorals, with the external rays thick and unforked. The first dorsal answers to the first half of the space between the ventrals and anal. They have twelve gill-rays, and large scales upon the cheeks, gill-lids, and body. One species inhabits the Mediterranean.

Sternoptyx, are little fishes with high compressed body, the mouth directed upwards, their humeral bones forming a trenchant crest forwards, and terminating below in a little spine. The pelvis formed by a small spine before the ventrals. There are small grooves on each side of the pelvic crest, which has been considered as a sternum, and hence their name. They have an osseous crest before the first dorsal, and a little membrane answering to the second. The borders of the mouth are formed by the maxillaries. Two species are found in the Atlantic, which may become types of two distinct genera. One of these has five gill-rays, the other nine.

THE FIFTH FAMILY OF THE MALACOPTERYGII ABDOMINALES.

CLUPEIDÆ (the HERRING Family).

These have no adipose dorsal, and, as the Trout, they have their upper jaw formed in the middle by intermaxillaries without peduncles, and the sides by maxillaries. Their bodies are always scaly, and most of them have an air bladder and many cœca. Few of them ascend rivers, though they appear periodically upon the shores.

Clupea, the Herrings, have the intermaxillaries narrow and short, forming but a small portion of the jaw, which is completed on the sides by protractile maxillaries. The lower edge of the compressed body is notched by scales, resembling the teeth of a saw. The gill openings are so wide that the fishes die almost the instant they are out of the water. The gill arches towards the mouth pectinated, the stomach is an elongated sac, the air bladder long and pointed, and their bones are very slender and numerous. They consist of several subgenera.

Clupea, Herrings properly so called, with the mouth mean-sized, and the upper lip entire. *C. harengus* needs no description; it appears periodically in numerous shoals, [but does not breed in the Polar seas, as was once stated, as it gets southward into warm latitudes. Its flesh is dry and inferior]. *C. sprattus* resembles the Herring, but is much smaller. *C. alba*, White Bait, a small and delicate species, resorts to the top of the brackish water to mature its spawn. It is found in various estuaries, and is highly esteemed. *C. pilchardus* is about the size of the Herring, but has the dorsal more forward. It inhabits more southernly than the Herring, and is caught in vast numbers on the coast of Cornwall. *C. sardina*, the Sardine, is like the Pilchard, only smaller. It is taken in the Mediterranean, where the Herring is unknown, and also on the west coast of France. Its flavour is highly esteemed.

Alosa, has a notch in the middle of the upper jaw, but is in other respects like the Pilchard and Sardine. *A. vulgaris*, the Shad, is much larger and thicker than the Herring, growing to three feet in length, and it has no teeth, and a black spot behind the gills. In spring it ascends rivers, when it is much esteemed; but when taken in the sea is dry and disagreeable. *A. finta*, the Twaite Shad, has teeth in the jaws, and five or six dark spots along the side. It is the Common Shad of the British rivers; but is considered inferior to the Common Shad, or Alice Shad, as it is called, which, as a British fish, is by no means so common.

Chatoessus, resembles a Herring, only the first dorsal ray is prolonged in the filament. Some have the jaws equal, the muzzle not prominent, and the mouth small and without teeth. Others have the muzzle prominent, but the mouth small. The fibres of the first gills unite with those on the opposite side, and form under the palate curious pinnated points. These are from the warm seas, and they complete the subgenera of Clupea as at present arranged, though the following come appropriately after the Herrings, inasmuch as they have the belly sharp and notched.

Odontognathus, have the body very compressed, with three sharp teeth near the vent, a long but narrow anal, a small and feeble dorsal, which is always broken, six gill-rays, the maxillaries prolonged and a little pointed, and furnished with small teeth directed forwards, and no apparent ventrals. One species from Cayenne is known, resembling a small Sardine, but having the body more compressed.

Pristigaster, head and teeth as in the Herrings, four gill-rays, ventrals generally wanting, belly compressed, arched and toothed. They are found in both oceans.

Notopterus. Gill-lids and cheeks scaly; the suborbitals, pre-operculum, and operculum have two crests; the lower jaw is keeled, the belly toothed, and the palatals and jaws have fine teeth; the upper jaw formed in great part of the maxillaries. Their tongue is set with strong crooked teeth; they have one strong and bony gill-ray; ventrals hardly visible, followed by a long anal, which occupies three-fourths of the length, and is united, as in *Gymnotus*, with the fins of the tail and back; opposite the middle of the anal there is a small dorsal with soft rays. They are found in the stagnant fresh waters of India, being the *Gymnotus notopterus* of Pallas.

Fig. 143.—The Anchovy.

Engraulis, the Anchovies, distinguished from the Herrings by the mouth being more deeply cleft, the gill-openings wider, and ten or twelve gill-rays. The small intermaxillaries are fixed under a little pointed snout, in advance of the mouth, and the maxillaries are long and straight. *E. enchrasicholus*, the Common Anchovy, so well known for its rich and peculiar flavour, is about a span long, bluish above, silvery below, the abdomen not trenchant, the anal short, and the dorsal over the ventrals. Taken in vast numbers in the Mediterranean, and less abundantly in the ocean. *E. meletta* is a Mediterranean species. *E. edentulus*, an American species, without teeth.

Thryssa, differs from the Anchovies in having the belly toothed, and the maxillaries very long. It is an East Indian subgenus.

Megalops. Fins and jaws generally formed like those of the Herring, but the belly not trenchant, nor the body compressed; teeth in the jaws and palate very small and numerous; from twenty-one to twenty-four gill-rays; and the last ray of the dorsal, and often of the anal, extended in a filament. One American species, the Apalite, is found twelve feet long, has fifteen rays in the dorsal, and a filament to that in the anal. An Indian species has seventeen dorsal rays.

Elops, resembles the former, but is rather longer, wants the dorsal filament, has more than twenty gill-rays, and the caudal with a flat spine above and below.

Buterinus, has jaws like those of a Herring, a round and lengthened body, and prominent snout; the mouth shallow; the jaws with small, crowded teeth; and the tongue, vomer, and palate, have rounded ones, also closely set. There are twelve or thirteen gill-rays. This and the former genus are beautiful fishes, of a silvery colour, with many bones and cœca, and they grow to a large size.

Chirocentrus, has the upper jaw as in the Herring, with a row of stout conical teeth in both jaws, the two middle ones in front very long; the tongue and gill-arches toothed like a card, but not the palatal or vomer; seven or eight gill-rays, the latter ones very broad; a pointed scale above and beneath each pectoral; body long, compressed, and sharp, but not toothed on the belly; ventrals very small, and shorter than the anal, which is opposite; stomach and air-bladder long and slender. Only one known species, of the Indian Ocean, and silvery.

Hyodon, has the form of a Herring, but the belly not toothed, eight or nine gill-rays, and the teeth and the mouth like those of a Trout. Found in the fresh waters of North America.

Erythrinus. Upper jaw almost entirely formed of the maxillaries; conical teeth in the edges of each jaw; crowded teeth in the palatals; five broad gill-rays; head round, blunt, with hard bones, but no scales; body oblong, compressed, with scales like Carp; dorsal opposite the ventrals; stomach and air-bladder large; cœca small. Found in the tropical rivers, and esteemed as food.

Amia, have the head like the last, but twelve gill-rays, and a hard buckler on the under-jaw; pavement-teeth behind the conical ones; nostrils tubular; stomach large; intestine wide, and with no cœca; air-bladder cellular, like the lung of a Reptile. Found in the rivers of the southern states of America, feeds on Crustacea, and is rarely eaten.

Sudis,—fresh-water fishes resembling Erythrinus, but having the dorsal and anal placed opposite each other, and occupying the last third of the body. They inhabit the rivers of tropical countries.

Osterglossum, differs from the last by having two cirri suspended from the lower jaw, and the tongue closely toothed like a rasp. A large species inhabits Brazil.

Lepisosteus, have long teeth in the edges of the jaws, and their anterior surfaces rasp-like; the scales as hard as stone; the dorsal and anal opposite, and far back; the intestine with two folds, and numerous cœca; air-bladder cellular. Of tropical America, grow large, and are good eating.

Porypterus. Sides of the upper jaw immoveable; head covered with sharpened bony plates; body with strong scales; one gill-ray; a number of separate fins on the back; the teeth like a rasp, with long ones in front; the stomach large; double air-bladder, with large lobes, the left one opening freely into the gullet. They are found in the African rivers, and are eatable.

THE THIRD ORDER OF BONY FISHES,—

MALACOPTERYGII SUB-BRACHIATI,—

Have the ventrals under the pectorals, and the pelvis suspended to the shoulder-bones [They are thus better adapted for ascending and descending than the abdominal fishes.]

THE FIRST FAMILY OF THE MALACOPTERYGII SUB-BRACHIATI.

GADIDÆ (the COD Family).

This family are almost wholly included in the great genus *Gadus*, easily known by having the ventrals inserted under the throat, and pointed. The body is moderately long, a little compressed, and covered with small soft scales; the head is well-proportioned, but naked: all their fins are soft; the jaws and front of the vomer have unequal-pointed teeth, of medium or small size, disposed in several rows, like a card or rasp; the gill-openings are large, and there are seven rays. Most of them have two or three fins on the back, some behind the vent, and a distinct caudal fin. The stomach is a large and strong sac; and the intestine long, with numerous cœca. The air-bladder is large and strong, and often notched in the margins. The greater number live in the cold or temperate seas, and furnish a most important branch of the fisheries. Their flesh is white, easily separable into flakes, and, generally speaking, wholesome, easy of digestion, and agreeable to the palate. [Taken altogether, they are probably more really serviceable to Man than any other family of fishes. Their reproductive powers are great, and their numbers countless; and they have the advantage of being generally found in vast shoals, at particular places.] They can be subdivided as follows:—

Morrhua, Cod, properly so called, with three dorsals, two anals, and a cirrus at the point of the lower jaw. They are the most numerous and valuable of the family, consisting of three sections, or species:—*G. morrhua*, the Cod, two or three feet long, with the back spotted brown and yellow; inhabits all the north seas, and multiplies exceedingly in the colder latitudes. They are taken in vast numbers for salting, and also for immediate use. [Their appearance and quality vary a good deal with the nature of the ground.] *G. æglefinus*, the Haddock, brown on the back, silvery on the belly, with the lateral line, and a spot behind the pectoral fin, black. Almost as numerous in northern latitudes as the Cod, but less esteemed. [When the Haddock is taken in deep and clear water, it is perhaps the most delicate, and at the same time the most savoury of the whole family; but it does not take salt so well as Cod.] *G. callarius*, the Dorse, spotted like the Cod, but smaller, and with the upper jaw longest. It is much esteemed in the north, when eaten fresh. [Besides these, there are various sub-species, or varieties, of all the three kinds, some of them found on the British shores.]

Merlangus, the Whiting, with the same fins as Cod, but no cirri. Of these, *G. merlangus*, the Whiting, is well known from its abundance, and the lightness of its flesh. It is pale, reddish grey above, silvery below, has a long upper jaw, and is about a foot in length. *G. carbonarius*, the Coal-fish, twice the size of the Whiting, blackish brown, with the upper jaw short, and the lateral line straight. The flesh of the full-grown one is coarse and tough, but it takes salt like Cod. *G. polachius*, the Pollock, jaws like the Coal-fish, brown above, spotted on the flanks, and silvery below. It is abundant in the Atlantic; and better than the Coal-fish, but inferior to the Whiting.

Merluccius, the Hake, with only two dorsals, one anal, and no cirri, sometimes exceeds two feet; the back brownish grey, the first dorsal pointed, and the lower jaw longest. It is a coarse fish, but captured in great numbers, and salted. There are some species in high southern latitudes.

Lota, the Ling (which means the Long Fish), has two dorsals, one anal, and some cirri at the mouth. *G. molva*, from three to four feet long, olive above, silvery beneath, dorsals equally high, lower jaw a little shorter than the upper, and with a cirrus. This species salts well, and is not inferior to Cod: hence it is a very valuable object in the fisheries.

G. lota, the Burbot, from one to two feet long, yellow mottled with brown, dorsals of equal height, and one cirrus; head slightly depressed, and body cylindrical. It ascends rivers, and its flesh and flavour are highly esteemed. [The livers of most of the family are large, and furnish a great deal of oil, highly valuable in the dressing of leather, and other operations of the arts.]

Motella, the Rockling. Body lengthened, first dorsal scarcely perceptible, second and anal very long, and three or more cirri. *M. vulgaris*, the Three-bearded Rockling, has two cirri on the nose, and one on the lower jaw. It is fawn-coloured, with brown spots. *M. quinquecirrata*, the Five-bearded, has four cirri on the upper part, and one on the chin. It is dark-brown on the upper part, and seldom attains any considerable size.

M. glauca, the Mackarel Midge, is about an inch and a quarter long, bluish-green on the upper part, and silvery below, and on the fins. *M. argenteola*, the Silvery Gade, is also a small fish, with three cirri, and coloured nearly like the former.

Brosmius, the Torsk, is a northern species, with a long body, a dorsal along the whole back, one barbule on the under jaw, and the ventrals fleshy. It grows to the largest size in its native north.

Brotula, from the West Indian seas, with the dorsal, anal, and caudal, forming one fin, which ends in a point.

Phycis, Fork-beard, have a single ray in each ventral, which is produced and forked. They have also a small barbule on the chin. There are one or two British species.

Raniceps, the Tadpole Fish, has the head broad and depressed, and the first dorsal scarcely visible.

Lepidoleprus, a separate genus, having some relation to the Cod. Their suborbitals are united with the nasal bone, and form a depressed muzzle, advancing before the mouth, which, however, retains its mobility. Head and body with hard spinous scales; the ventrals are a little on the throat; the pectorals of mean size; the first dorsal high; the second dorsal, anal, and caudal united; the jaws short; the teeth fine and short. They inhabit

deep water, and utter a grumbling sound when drawn up to the surface. Two species are known, inhabiting the depths of the Mediterranean and Atlantic.

THE SECOND FAMILY OF THE MALACOPTERYGII SUB-BRACHIATI.

PLEURONECTIDÆ (the FLAT-FISH, or FLOUNDER Family).

These are all included in the great genus *Pleuronectes*, which have a character quite unique among vertebrated animals: this consists in the want of symmetry in the head. [An animal is said to be symmetrical when it is supposed to be divided in a mesial plane, or plane exactly along the middle, in a vertical direction,—the two sides being the exact counterparts of each other, and differing in nothing but in the one being turned to the right, and the other to the left.] These fishes have both eyes on one side, and this side always remains uppermost when the animal is swimming, [while all other fishes swim on the belly.] The upper side is in general deeply coloured, while the other side is whitish. The body, from the head backwards, though formed nearly as usual, partakes a little of this peculiarity. The two sides of the mouth are not equal, and the pectoral fins are rarely so; the body is depressed, and elevated in the direction of the spinous processes; the dorsal extends along the whole back; the anal occupies the lower edge of the body, and the ventrals are sometimes united with it. [The fins are thus lateral fins, in respect of the swimming of the fish when in motion; and the action of the spine is vertical, in respect of that position, and not lateral, as in other fishes.] They have six gill-rays; the abdominal cavity is small, but extends in a cavity imbedded in the flesh on the two sides of the tail, for the purpose of containing some of the viscera; they have no air-bladder, and they seldom rise far from the bottom. Notwithstanding the peculiarity of the cranium, by that twist of the neck which brings both eyes to one side, the bones are the same as in other families, but very differently proportioned. They are found along the shores of almost all countries; and are, generally speaking, wholesome and agreeable eating.

Some individuals have the eyes placed in the opposite side to that in which they are generally found in their species, and these are said to be reversed. Others have both sides coloured alike, in which case they are called "Doubles." It is usually the coloured side which is doubled, though occasionally it is the white one. They are subdivided as follows

P. platessa, Plaice, have a row of sharp teeth in each jaw, and very often pavement-teeth in the pharynx; the dorsal does not advance more forwards than the upper eye, and both it and the anal terminate and leave smooth spaces before the base of the caudal; they generally have two or three small cœca, and six gill-rays. *P. vulgaris*, Common Plaice, has six or seven tubercles, forming a line between the eyes, and spots of Aurora red over the brown on the upper side of the body. The height is but a third of the length; and the flesh is soft, and soon decomposes. *P. flesus*, the Flounder, similar, but with the spots lighter; some tubercles on the head, and some on the base of the dorsal and anal fins; and have rough scales on the lateral line. They ascend a considerable way up rivers, and reversed individuals are not unfrequently caught. *P. limanda*, the Dab, has the eyes large, the lateral line curved above the pectoral, the scales rough, and the upper side brown, with whitish spots. *P. microcephalus*, the Laminder, with the eyes smaller, nearer each other, and the back finely mottled with brown and yellow. [Both these are found in the salt water, as is also *P. leminoides*, the Long, or Rough Dab, which has the body elongated, something like a saw, and it approaches that species and quality. *P. pola*, the Crayed Fluke, has the head small, the right eye considerably in advance of the left, with the body yellowish-brown, and the fins darker. [All these, and some other species, are found on the British shores, chiefly on muddy or sandy bottoms.]

Hippoglosus, the Halibut. Shape and fins like a Flounder, lateral line arched, attains the length of six or seven feet in the northern seas, and weighs from three to four hundred pounds. Its flesh is rather coarse and dry, but it admits of being salted. There are several small species in the Mediterranean, some of which have the eyes on the left side, [whereas all the others hitherto noticed have them on the right side, unless when understood to be reversed;] and one is oblong, with a straight lateral line, and large scales.

Rhombus, the Turbot genus. Teeth as in the Halibut, but the dorsal advances in front of the eyes, and the anal comes to the edge of the jaws. The eyes are generally on the left, and in some they are separated by a low crest. *R. maximus*, the Turbot, is the most esteemed of the family. Its height is nearly equal to its length, its form a truncated rhombus, and with the lateral line much arched. The upper or left side is brown, and beset with tubercles; but reversed specimens are sometimes taken. *R. vulgaris*, Brill, is rounded on the sides, has the body without tubercles, and the first rays of the dorsal split into filaments. The eyes are usually on the left side. It is not so much esteemed as Turbot, still it is a good fish. *R. hirtus*, Topknot: mouth small, almost vertical; teeth distinct and sharp; colour reddish-brown, mottled with black, with a large spot on the lateral line near the tail, but not so conspicuous as in one other species, which has the body turned the other way, or the eyes on the right side, and the lateral line nearly straight. *R. megastoma*, the Whiff: body oblong, mouth wide, lateral line nearly straight, upper colour brown: it is not much esteemed. *R. arnoglossum*, the Scarlet Fish: oblong, eyes to the left, fin-rays extending beyond the membrane, and of a yellowish-brown colour.

Solea, the Sole. Eyes on the right, mouth twisted in the opposite direction, and with teeth only in the sides opposite to the eyes; form oblong; snout rounded, generally in advance of the mouth; dorsal and anal margining all the sides of the body. *S. vulgaris*, the Common Sole, is dark-brown on the upper part, with a strong skin and small scales, and white on the under. *S. pegusa*, the Lemon Sole, is paler in colour, and wider and thicker than the Common Sole. All the Soles are excellent fishes, and may be had in good condition nearly all the year.

Menochirus, resembles the Sole, but has only one small pectoral on the same side with the eyes, which is the right side in all the Soles. The Variegated Sole of the Mediterranean—occasionally found on the British coast—is an example.

Achirus, are Soles entirely without pectoral fins, some having the ventrals distinct, and others having them united to the anal.

THE THIRD FAMILY OF THE MALACOPTERYGII SUB-BRACHIATI.

DISCOBOLI (Fishes with the ventrals formed into a Sucker, or Disc).

The disc formed by the ventrals is the family characteristic, and they consist of two genera, both of which have the power of attaching themselves to rocks and other hard substances, by means of the disc, and thus they are capable of remaining in situations where otherwise the current of the water would carry them away. [This curious property enables these fishes to remain and find their food in situations where every other species of fish would be swept away by the current of the water.]

Lepidogaster.—These small fishes have large pectorals reaching to the under-side of the body, where they consist of stouter rays, incline forwards, and unite with each other by a transverse membrane directed forwards under the throat, and composed of the united ventral fins. Body without scales; head broad and depressed; snout curved and protractile; gills with little opening, and four or five rays; only one soft dorsal opposite the anal, and both reaching to the base of the caudal. Intestines short, straight, and without cœca. They have no air-bladder, but they swim briskly. There are two subgenera:—

Lepidogaster, properly so called, have the membranes representing the ventrals extended to one complete disc; and behind this, another disc, formed by the united pectorals. Some have the dorsal and anal united to the caudal, and others not. [There are several British species found on the south and west coasts; but they are small, and of no interest, except to naturalists.]

Gobiesox, have the disc entire, but with a cleft on the sides, and the membrane produced; the gill-opening wider, and the dorsal and caudal smaller, and separated from the anal. [Of this there is one small British species, not above an inch and a half in length, bright red above, and paler below. The sucker adheres readily to any wet surface, but not to a dry one.]

Cyclopterus.—Rays of the ventrals suspended round the pelvis, united by a single membrane, and forming the disc; mouth wide; small pointed teeth in the jaws and pharynx; gill-lid small, and opening close below; six gill-rays; pectorals large, almost meeting under the throat, so as to surround the disc there, but forming no part of it. Their bones are soft; skin naked and mucous, but studded with hard granulations; stomach large, and with numerous cœca; intestine long; air-bladder moderate. There are two subgenera:—

Lumpus, have the first dorsal more or less visible, but with simple rays; the second opposite the anal, with branchial rays; the body is thick. [The Lump-fish is found in the British seas, and as far north of them as the margin of the polar ice. When in good condition for the table, it is red, or rather various shades of blue, purple, and reddish orange; but when out of season, it fades to a dull blue. It attains considerable size, and is a high and thick fish,—the height being about half the length, and the thickness half the height.]

Leparus, with a single dorsal, and this and the anal both long; the body long, and compressed towards the tail. [There are one or two British species, some of which are called "Snail-fishes," from their soft and unctuous texture, and the readiness with which they adhere to rocks.]

Echeneis. This genus, like Pleuronectes, might form a distinct family of Sub-brachial Malacopterygii. They have a disc on the head, formed of cartilaginous laminæ, ranged transversely or obliquely backwards, and with teeth or spines on their posterior edge. These are moveable, so that by means of them the fish can attach itself firmly to a rock, the bottom of a ship, or any other substance; and it is owing to this that it used to be alleged that these fishes could at once arrest the course of the swiftest vessel. Body long and scaly, a small dorsal opposite the anal, top of the head flat, lower jaw projectile, teeth small, tongue and vomer rough, eight gill-rays, large stomach, short intestine, six or eight cœca, and no air-bladder. This species are not numerous, and they inhabit generally the warmer seas. [*E. remora*, the Common Sucking-fish, is abundant in the Mediterranean; and has been met with as a straggler on the British shores,—Dr. Turton having found one riding on the back of a Cod-fish, at Swansea, in 1806. The West Indian species are larger.]

THE FOURTH ORDER OF BONY FISHES.

MALACOPTERYGII APODA.

The fishes in which ventral fins are always wanting, form but one natural family.

Murænidæ, or Eel-shaped Fishes, which are lengthened in form, have the skin thick and soft, the scales almost invisible, and but few bones. They have no cœca, but almost all have air-bladders, often singularly shaped.

The genus *Muræna* is easily known by small operculæ, surrounded by concentric rays buried in the skin, and opening only by a hole at some distance backwards, which arrangement, by protecting the gills, enables these fishes to live long out of the water, [and crawl for some distance over-land, when such a journey is necessary.] Body long and slender, scales visible only on the dried skin, no ventrals or cœca, and the vent far backwards. This extensive genus may be subdivided as follows:—

Anguilla, known by the pectoral fins, and the gill-openings under them; stomach a long cul-de-sac, intestine straight, and a peculiar gland near the middle of the long air-bladder. They are again subdivided:—*Anguilla,* the true Eels, have the dorsal and caudal meeting at the extremity of the tail, and forming a point, and the dorsal beginning a considerable way behind the pectorals. [They have also a singular pulsatory apparatus for the circulation of lymph, situated near the extremity of the tail. They are, strictly speaking, fresh-water fishes.; but they migrate to the sea in the end of the season, bury themselves in the sludge there, and mature their spawn, again ascending the rivers for the purpose of spawning. Like Trout, they are much affected in appearance and quality by the waters which they inhabit. Three species are known as British Eels:—*Acutirostrus,* the Sharp-nosed Eel; *Latirostrus,* the Broad-nosed Eel; and *Mediorostrus,* the Snigg Eel. Eels are delicate fishes, and not found in very high latitudes. In Britain they are most abundant, and best in quality in the pure rivers which rise in the chalk districts.]

Conger.—Dorsal commencing near or at the pectorals, and upper jaw longest. The Conger is found in most European seas; and is sometimes from four to six feet long, and as thick as a man's leg. The margins of the dorsal and anal are black, and the lateral line marked with white spots. *C. myrus* of the Mediterranean is smaller than the Conger, and has whitish spots on the snout and the occiput. In some foreign ones, the dorsal begins before the pectorals.

Ophisurus, Snake Eels, differ from the former in having a portion of the extremity of the tail without fins, and ending in a pouch like the tail of a Serpent. *O. serpens* of the Mediterranean is brown above, silvery beneath, nas the snout slender and pointed, grows to the length of six feet or more, and is as thick as a man's arm. Some foreign species have the pectorals much smaller, which gives them a little the appearance of the genus,—

Muræna, which have no pectorals, very small gill-openings, gill-lids thin, and the rays not easily discernible; the stomach short; the air-bladder small, and placed in the upper part of the cavity. Some have one row of sharp teeth in each jaw, among which is,—*M. helena,* common in the Mediterranean, and much esteemed by the ancients, who carefully fed it in ponds. The story of Vædius Pollio, who caused his offending slaves to be flung alive into the ponds to feed the Murænæ, is well known. They grow to the length of three feet or more, are mottled brown and yellow, and very voracious and ugly.

Others have two rows of sharp teeth in each jaw, and one on the vomer; and others, again, have round or conical teeth, as *M. unicola* of the Mediterranean, which appears uniformly brown, though marked with small lines and modellings. Others have two rows of teeth on the vomer, and a single one on the jaws; others, again, have two rows on the jaws, and four, like a pavement, on the vomer; and others still have several rows of card-teeth, as *M. saga,* with long, round, and pointed jaws, and the tail ending in a very sharp point.

Sphagebranchus, have the gill-openings near each other below, the fins apparent only near the tail, and the snout long and pointed. Some want pectorals, others have mere vestiges, and others still are totally finless.

Monopteras, have the gill-openings united, but with a partition; the dorsal and anal apparent only from the middle of the tail backwards; card-teeth on the jaws and palate; six gill-rays, and only three very small gill-arches. The known species is from the Moluccas, and it is green above and fawn-coloured below.

Synbranchus.—Gill-opening entirely single, no pectorals, fins fatty, head thick, snout rounded, operculum cartilaginous, with six rays, stomach and anal perfectly straight, and bladder long and narrow. Found in the seas of hot countries.

Alabes, have one gill-opening; pectorals well marked, with a disc between them; gill-lids small, with three rays; teeth pointed; and intestines as in the last. The well-known species inhabits the Indian Ocean.

Here should be placed a recently-discovered fish, one of the most singular of the whole class, namely:—

Saccopharynx, which can inflate the thorax to a large tube, which terminates in a very long and slender tail, with long upper and under fins meeting at the point. Teeth sharp, mouth opening behind the eyes, which are very near the point of the snout, and gill-opening a small hole under the pectorals. Grows large, and appears to be voracious; but only a few specimens have been seen floating in the Atlantic, by means of the inflation of the thorax.

Gymnotus.—Gills partially covered by membranes, but opening before the pectorals; vent far forwards; anal fin occupying the under line of the body, generally to the extremity of the tail, but no dorsal. They admit of subdivision:—

Gymnotus, the true Electric Eels, have no caudal or dorsal fin, nor visible scales; moderate intestines, with several flexures, and numerous cœca; stomach short, and plaited on its inner surface. One long air-bladder extends in a cavity of the abdomen; the other, in two lobes, is placed over the gullet. Found only in the rivers and stagnant fresh waters of tropical America; and the most celebrated is,—

G. electricus, the Electric Gymnotus, called from its form the Electric Eel. It attains the length of five or six feet, and communicates shocks so powerful that men and horses have been stunned by them. This power is voluntary, and can be sent in a particular direction, and even through the water, the fish in which are killed, or stunned, by its shocks. By giving these, it is greatly exhausted, and requires both rest and nourishment before it can renew them. The immediate organ of this power extends along the whole under-side of the tail, occupying about half its thickness. It consists of two large longitudinal fasciculi above, and two smaller ones below, resting on the base of the anal fin. Each fasciculus is composed of numerous parallel membranes, nearly horizontal, and close to each other, one end being attached to the skin, and the other to the mesial plane. They are joined by numerous transverse and vertical membranes; and the canals and cells thus formed are filled with gelatinous matter. The whole apparatus is largely supplied with nerves, [affording one striking instance of the intimate connexion between electric or galvanic action in matter, and nervous action in living animals.]

Carapus, has the body compressed and scaly, and the tail much narrowed. They live in the South American rivers.

Stenarchus, have the anal separated from the tail, and a caudal,—a soft filament along the back, lodged in a groove, in which it is retained by tendinous threads, and reaching the whole way to the tail. It has some freedom of motion, but the use of it is not known. The head is oblique, compressed, and naked, with the skin hiding the operculum and gill-rays; the body scaly; the teeth small and crowded, and scarcely discernible in the middle of the jaw. Like the rest of the genus, they inhabit the waters of South America.

Gymnarchus.—Body long and scaly; gill-opening before the pectorals; a soft-rayed fin along the back, but no anal, and the tail ending in a point; head naked and conical; mouth small, and with a single row of cutting-teeth. *G. niloticus*, the only known species, inhabits the Nile.

Leptocephalus.—Gill-opening before the pectorals; body compressed and ribbon-like; head very small; snout short, and a little pointed; pectorals nearly or totally wanting; dorsal and anal obscure, but extending to the point of the tail; the viscera occupying a small cavity along the under-part of the body. One species is found in the British seas. *L. morrissii*, the Anglesey Morris, is a very little fish, silvery, and semi-transparent, but with bright and prominent rays, and is very lively in its motions. It lurks in sea-weed; and is one of those animals, exceedingly rare among Vertebrata, of which the internal structure can be seen without dissection, and its action understood accordingly. Other species have been found in the warm seas.

Ophidium, resembles the Eels in having the vent far backwards, and the dorsal and anal meeting at the point of the tail; and the body is so long and compressed, that the fish has been compared to a sword-blade. The skin has minute and buried scales, as in the Eels, but the gill-openings are large, and the gill-lids have free motion; the dorsal rays are joined, not branched; some have small barbules, others none, and some short cirri; some are flesh-coloured, with black fins; some brown, and some large ones are rose-colour, with brown spots.

[The species without cirri, the *O. imberbis* of Linnæus, has been made a subgenus by Cuvier, under the name of *Fierasfer*, in which the dorsal seems a mere fold of the skin. A specimen, about three inches long, has been met with on the south coast of England].

Ammodytes, have the body like the former, a fin with simple-jointed rays along the back, an anal fin, and a forked caudal, and the fins are not united; snout sharp; upper jaw extensile, and shorter than the lower in the closed mouth; stomach fleshy and pointed; no cœca, or air-bladder. They burrow in the sand, and are captured by digging it at low water; and are understood to contribute materially to the support of Salmon in the estuaries. There are two species:—*A. tobianus*, the Sand-eel; and *A. lancea*, the Sand-lance. The latter is thicker in the body than the former, with the intermaxillaries larger, and the dorsal commencing farther forward. They are both found on the sandy shores of Britain.

THE FIFTH ORDER OF BONY FISHES.

LOPHOBRANCHII (FISHES WITH THEIR GILLS IN TUFTS).

All the fishes of the preceding four orders not only have a skeleton of fibrous bones, and the jaws complete and free, but their gills are always in fibres or fringes, like the teeth of a comb; but those of the present order, while they have the jaws complete and free, have the gills not in equal laminæ along the arches, but in small round tufts, disposed along the arches in pairs,—a structure of which there is no instance in other fishes. These are defended by a large operculum, attached by membranes on all sides, except one small hole for allowing the water to escape; and mere vestiges of rays are shown in the substance of the operculum. These fishes are also distinguished by shields or small plates, which cover the body, and often give it an angular form. In general, they are of small size, and almost without flesh. Their

intestine is of uniform width, and without cœca; and their air-bladder, though slender, is large in proportion to their size. They form two genera; and the first admits of subdivision.

Syngnathus.—These are characterized by a tubular snout, composed, as in the Fistularidæ, of prolongations of the ethmoid, vomer, temporals, pre-operculum, and other bones; and this snout ends in a mouth as in other fishes, only its opening is nearly vertical. The gill-opening is near the nape; and there are no ventral fins. In their reproduction there is this peculiarity, that the eggs slide into a pouch formed by an inflation of the skin, and remain there till they are hatched. This pouch is under the belly in some, and at the base of the tail in others. It bursts spontaneously, and allows the fry to escape. [Thus these fishes have some analogy to the marsupial Mammalia.]

Syngnathus, the Pipe-fishes, properly so called, have a very long and slender body, differing little in diameter throughout its entire length. Some have a dorsal, caudal, and anal; others want the anal only, and in these the hatching-pouch is situated under the tail. *S. acus*, the Great Pipe-fish, and *S. tylphe*, the Peak-nosed Pipe-fish, both found in the British Seas, belong to these sections. Others, again, have neither anal nor pectorals; and others no fin but the dorsal. *S. ophidion*, the Snake Pipe-fish, and *S. lumbriciformis*, the Worm Pipe-fish, are British fishes belonging to these sections. [They have the pouch under the belly; and it is to be observed that in all the species it is the male, and not the female, which has the pouch, and hatches the eggs.]

Hippocampus, has the body compressed laterally, and much more elevated than the tail; and in dead specimens the neck bends, and the upper part has a faint resemblance to the head and neck of a Horse in miniature, from which they have been called Sea-horses. The margins of their scales are formed into ridges, and the angles into spines. They have no fin in the tail, but that organ is prehensile, and enables them to climb or hold on by the stalks of marine plants. The common species is found in the British seas, and is sometimes about five inches long; and, on the coast of Australia, there is a longer one, with the angles of the scales extended into leafy appendages.

Solenostomus, differ from the former chiefly in having, behind the pectorals, large ventrals united with each other and with the body, and forming an apron which serves to retain the eggs while hatching, in the same manner as the pouch of the Pipe-fishes. There is one dorsal of few rays near the nape, a very small one near the tail, and a large pointed caudal, but otherwise they resemble Hippocampus. The only known species is from the Indian Ocean.

Pegasus, have a snout as in the former, but the mouth under it, and moveable, like that of a Sturgeon, only composed of the same bones as in other osseous fishes. The body is armed as in Hippocampus, but their thorax is broad, depressed, and with the gill-openings in the sides. They have two distinct ventrals in rear of the pectorals, which are often large, and have procured these fishes the name of Pegasus, or Flying Horses. The dorsal and anal fins are opposite each other, the abdominal cavity is wider and shorter than in Syngnathus, and the intestine has two or three flexures. Some species are found in the Indian seas.

THE SIXTH ORDER OF BONY FISHES.

PLECTOGNATHI (FISHES WITH SOLDERED JAWS).

Though retaining many of the characters of the Bony Fishes, the members of this order resemble the Cartilaginous ones, in the imperfect structure of the jaws, and the slow ossification of the skeleton; but still this skeleton is fibrous, and resembles that of the Bony Fishes. The chief characters are—the maxillary soldered to the side of the intermaxillary, which constitutes the jaw, and the connexion of the palatal arch with the cranium by an immoveable suture. Besides, the gill-lid and rays are concealed under the thick skin, with only a small opening, the ribs are mere rivets, and there are no true ventrals. The intestine is large, and without cœca; and the air-bladder is always ample. They admit of division, by the character of their teeth, into two very natural families.

THE FIRST FAMILY OF THE PLECTOGNATHI.

GYMNODONTES (Fishes with naked Teeth).

Instead of teeth, these have the jaws covered with a substance like ivory, laminated internally, and resembling the beak of a Parrot, though these are true teeth united, and are reproduced as soon as they are destroyed by using. Their gill-lids are small, with five obscure rays. They live on Crustacea and sea-weed, and their flesh is mucous, and not liked,—that of some species being reckoned poisonous, at least at certain seasons of the year.

The genera *Tetraodon* and *Diodon* have the faculty of blowing themselves up like balloons, by filling with air a thin and extensile membranous sac, which adheres to the peritoneum the whole length of the abdomen. When thus inflated, they roll over and float with the belly uppermost, without any power of directing their course; but they are remarkably well defended by spines all over the surface, which are erected as they are inflated. Their air-bladder has two lobes. They have but three gill-arches in a side; and when taken, the escape of the air from the pouch makes a sound. Each nostril is furnished with a double fleshy tentaculum.

Diodon, Spinous Globe-fishes, get the generic name from the jaws consisting of only two pieces, one above and the other below. Behind the trenchant edge of each piece, there is a rounded portion furrowed across, and forming a powerful grinding apparatus. The spines upon the inflated skin, which vary a good deal in the different species, present a formidable appearance. They inhabit the warm seas; but sometimes, though rarely, a specimen, brought no doubt by the Atlantic current, is found on the coast of Cornwall.

Tetraodon, have each jaw marked with a suture, so as to give the appearance of four teeth. The spines are small and low, and some species are reckoned poisonous. None of them is recorded as visiting Britain. One is electrical, *T. lineatus*, straight, brown and whitish: it is found in the Nile, cast on shore by the inundations, and collected by the children as a plaything.

Orthagoriscus, the Sun-fish, has the body compressed, spineless, and incapable of inflation, with the tail so short that it appears only the anterior half of a fish which had been cut in two in the middle. Their dorsal and anal, both high and pointed, are united to the caudal; no air-bladder, and the stomach is small; their surface is covered with mucus. They are found in many seas; and two species at least—*O. mola*, the Short Sun-fish, and *O. oblongus*, the Oblong Sun-fish—are found in the British seas.

Triodon.—These species have the mark of a suture on the upper jaw, but none on the under, which gives them the appearance of having three teeth. A vast membrane, as long as the body, and twice as high, is supported before by a large bone answering to the pelvis, and makes these fishes resemble Balistes, in the following family. Fins as in Diodon, body rough like Tetraodon, and the surface of the membrane roughened by a number of little oblique crests. The only known species is from the Indian Ocean.

THE SECOND FAMILY OF THE PLECTOGNATHI.

SCLERODERMI (Fishes with Hard or Granulated Skins).

These are readily distinguished by a conical or pyramidical muzzle, which is prolonged forwards from the eyes, and terminates in the mouth, with distinct teeth in both jaws. The skin is either rough or covered with very hard scales; and the air-bladder is large, strong, and of an oval shape. There are two genera. *Balistes*, File-fishes, admit of subdivision, and have the body compressed; eight teeth, generally trenchant, in a single row in each jaw; the skins scaly or granulated, but not osseous; the first dorsal composed of one or more spines, articulated with a particular bone, which is attached to the cranium, where is a groove for its reception; the second dorsal and anal long, and placed opposite each other. Though without ventral fins, they have pelvic bones attached to the shoulders. They abound in the warm seas near rocks, or on the surface of the water; and their brilliant colours sparkle in the water like those of Chetodons. Their flesh is disliked at all times; and they are supposed to feed on Coralline Polypi at some seasons, and become poisonous, but Cuvier found only sea-weed in such as he opened.

Balistes **proper**, have the whole body covered with long and hard rhomboidal scales, which do not overlap each other, but have the appearance of the teeth of a file; three spines on the dorsal, the first long, the third small and far back; extremity of the chest salient and prickly, with some spines in the skin behind, which have been considered as rays of ventral fins. Some have no particular armature of the tail; and of these, again, some have large scales behind the gill-openings. Such is the European File-fish—*B. capriscus*, which has been occasionally, but very rarely, found on the British shores, and which is common in the Mediterranean.

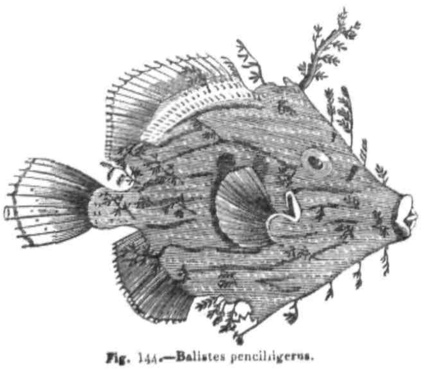

Fig. 144.—Balistes penciligerus.

Monacanthus.—This subgenus has very small scales, set rough like the pile of velvet; a large cirrated spine on the first dorsal, and the extremity of the pelvis salient and spinous. Some have the pelvic bone moveable, and connected with the abdomen by an extensile membrane, and frequently strong spines on the sides of the tail. Some have stout bristles on the tail, some have the body with tubercles, and others with branched hairs.

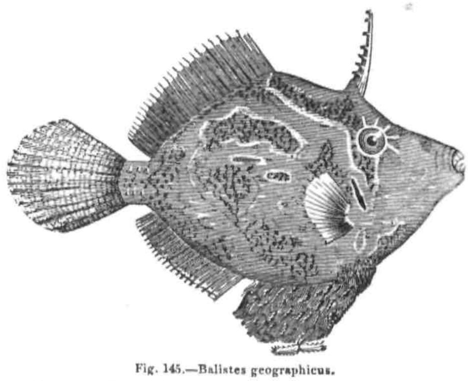

Fig. 145.—Balistes geographicus.

Aluteres, have the body long, the granulations scarcely visible, and a single spine in the first dorsal, but the pelvis is completely hidden in the skin.

Triacanthus, has a kind of ventrals, each supported by one large spinous ray, adhering to a non-projecting pelvis; the first dorsal has one largish spine, and three smaller ones behind it; the body is crowded with small scales; and the tail is longer than in any of the other subgenera. The single known species inhabits the Indian Ocean.

Ostracion, the Trunk-fish, has the head and body covered in such a manner with plates of bones, soldered together, as to form an inflexible cuirass, leaving only the tail, the fins, the mouth, and a small margin of the gill-opening, capable of motion,—all of which moveable parts pass through openings of the cuirass. The greater part of the vertebræ are also soldered together. The jaws are furnished with a row of ten or twelve conical teeth; and they have no apparent gill-opening, except a mere slit with a cutaneous lobe; but inside the skin they have a gill-lid and six rays. They have neither pelvic bone nor ventrals, and the single dorsal and anal are both small: they have little flesh, but the liver is large, and abounds in oil; the stomach is also very large and membranous. Some of them are thought to be poisonous. They might be subdivided according to the form of the body and the spines, but it is not yet ascertained whether there may not be sexual differences in these respects. [The body is triangular in some, quadrangular in others, and in some it is compressed; and the appearance of the cuirass, or covering, varies still more. None has been met with on the British shores.]

CHONDROPTERYGII.

The second series of Fishes, the CHONDROPTERYGII, or Cartilaginous Fishes, cannot be considered either superior or inferior to the Ordinary Fishes; for, while some of the genera resemble Reptiles in the structure of their ear and reproductive organs, other genera have the skeleton so very rudimental that one almost hesitates to regard them as vertebrated animals. They form a series, ranging parallel to the Bony Fishes, just as the Marsupial Mammalia range parallel with the other ordinary Mammalia.

Essentially, the skeleton is cartilaginous,—that is to say, it has no bony fibres, but the calcareous matter is disposed in grains. The cranium is always formed of a single piece without sutures; but there are ridges, furrows, and holes, whereby the portions of it analogous to the cranial bones of other fishes may be distinguished. Even the moveable articulations of other orders are not distinguishable in the whole of this: as, for instance, part of the vertebræ of some of the rays make a single piece, and some articulations of the bones of the face also disappear. Among the latter, the most prominent character is the reduction of the maxillaries and intermaxillaries to mere rudiments concealed under the skin, while their functions are performed by the palatals, and sometimes by the vomer. The gelatinous substance which fills the intervals of the vertebræ in other fishes, and communicates from one to another by only a small hole, is, in several of this order, a long cord, which traverses all the vertebræ, with little variation of diameter.

The series divides itself into two orders:—Those with free gills, like all other Fishes; and those with fixed gills, which are so attached to the skin by the internal edges that the water cannot escape from their intervals, except by holes in the surface.

THE FIRST ORDER OF CHONDROPTERYGII,—

CHONDROPTERYGII BRANCHIIS LIBERIS,—

(Or, with free gills), have in their gills a single wide opening, and a gill-lid, like the Bony Fishes, but they have no gill-rays. There are two genera.

Accipenser, the Sturgeon.—General form like that of the Shark, but the body more or less covered with bony plates in longitudinal rows, and the head externally armed with the same. Their mouth, placed under the muzzle, is small and toothless; and the palatal bones, soldered to the maxillaries, form the upper jaw, while there are vestiges of the intermaxillaries in the thick lips. Placed upon a pedicle of three articulations, this mouth is more protractile than that of the Shark; the eyes and nostrils are on the sides of the head, and barbules are suspended from the muzzle; the labyrinth within the cranial bones is perfect, but there is no external ear—the hole behind the temple leading merely to the gills. The dorsal is behind the ventrals, and has the anal directly opposite to it; the caudal surrounds the extremity of the spine, and terminates in the upper lobe of the tail, but an under lobe gives the tail the appearance of being forked. Internally, we find the spiral intestinal valve, and the single pancreas of the Shark family; and there is a very large air-bladder, which communicates with the gullet by a large opening. Sturgeons ascend some rivers in vast numbers, and are the object of valuable fisheries. The flesh of most is agreeable, their eggs or roes are made into caviar, and their air-bladders furnish the finest isinglass.

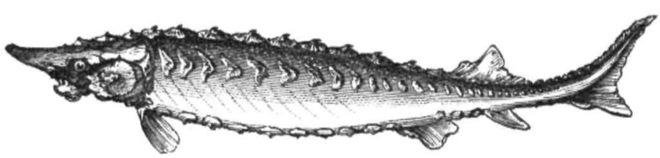

Fig 146.—The Sturgeon.

A. sturio, the Common Sturgeon, occasionally found in the west of Europe and on the British shores, is about six feet long, has a pointed muzzle, five rows of plates with strong spines, and its flesh is much esteemed, being somewhat like veal. The rivers falling into the Black and Caspian Seas produce this and three other species, if not more. *A. ruthenus*, the Sterlet, is seldom more than two feet long, with the plates on the lateral line numerous and keeled, and those in the belly flat. It is considered delicious, and caviar made from it is reserved for the Russian court. There is reason to believe that this is the *Elops* and *Accipenser* so much celebrated by the ancients. *A. stelatus*, the *scroregia* of the Russians, and the *scherg* of the Germans, grows to the length of four feet, has the plaits rougher and the snout more slender than the others. It is very numerous, but less esteemed than the Common Sturgeon. *A. huso*, the Great Sturgeon, has blunter plates, a smoother skin, and shorter snout and cirri, than the Common Sturgeon. It is frequently found more than twelve, or even fifteen, feet in length, and weighing more than twelve hundred pounds. One specimen is mentioned which weighed near 3,000 pounds. Its flesh is not much esteemed, and it is sometimes unwholesome; but its air-bladder yields the very finest isinglass. It is found in the Po as well as in the northern rivers.

Several Sturgeons are found in North America, which are peculiar to that quarter of the world.

Poliodon, may be considered as a subgenus of Accipenser. These fishes are distinguished by the great prolongation of their snout, the broad margins of which give it the figure of a leaf. In the general form and fins they resemble the Sturgeons; but their gill-openings are wider, and the gill-lid is prolonged in a membranous flap, which extends to half the length of the body; their gape is much cleft, and furnished with a number of small teeth. Their upper jaw is formed by the union of the palatals and maxillaries with a pedicle of two articulations. There is a spinal cord like that in the Lamprey, and the same spiral valve which is common to most of the order; but the pancreas is partially divided into cœca. They are furnished with an air-bladder. Only a single species is known, *P. folium*, which is found in the Mississippi.

Chimæra.—This second genus of cartilaginous fishes with free gills, closely resembles the Sharks in form, and in the disposition of the fins; but the gills open externally by one apparent hole in each side, though, if we examine more closely, we find great part of their edges attached, and that there are five separate holes terminating in the common aperture: still they have a vestige of an operculum concealed in the skin. Their jaws are more reduced than in the Sharks, for the palatals and temporals are mere simple vestiges suspended to the sides of the muzzle, and the upper jaw is represented by the vomer only: hard and undivided plates supply the place of teeth, four of them above, and two below. The muzzle, supported as in the Sharks, projects forwards, and has pores arranged in rows nearly

regular. The first dorsal, containing a strong spine, is placed over the pectorals; and the males, as in the Sharks, have a bony appendage to the ventrals; but these are divided into three branches, and they have spinous appendages before the base of the ventrals, and small spines on the point of a fleshy appendage between the eyes. Their eggs are large and flattened, with a leathery covering, and having margins. [In fact, with some singular peculiarities, they approach pretty closely to the fishes with fixed gills.]

C. monstrosa, the King of the Herrings, and Cat of the Mediterranean, is three feet long, and of a silvery colour spotted with brown. It inhabits the European seas, the northerly ones most abundantly. Another, forming, perhaps, a second subgenus, *Callirhynchus*, has the snout ending in a fleshy appendage like a toe. The second dorsal begins over the ventrals, and terminates at the commencement of the fin under the tail. Only one species, from the South Seas, is known.

THE SECOND ORDER OF CHONDROPTERYGII.

CHONDROPTERYGII BRANCHIIS FIXIS.

These have their gills attached at the outer edge, with a separate opening, through which the water from each gill escapes. They have also small arches of cartilage suspended in their muscles, opposite the gills, which may be called gill-ribs. They form two families.

THE FIRST FAMILY OF THE CHONDROPTERYGII BRANCHIIS FIXIS,—

SELACHII (the SHARKS and RAYS),—

Which has been comprised in two genera, has many common characters. The palatals and postmandibularies are alone armed with teeth, supplying the place of jaws, the usual bones of which are mere rudiments, a single bone representing the tympanal, jugal, and temporal bones, and the preoperculum. The *os hyoides* is attached to this pedicle, and supports gill-rays as in ordinary fishes, although not distinctly visible externally. It is followed by branchial arches, but has none of the three pieces which compose the gill-lid. They have pectorals and ventrals, the latter behind the abdomen on each side of the vent. Their membranous labyrinth is inclosed in the cartilage of the cranium, and their cavities contain starchy masses and not stony ones. The pancreas is a conglomerate gland, and not divided into cœca; the intestinal canal is short, but with a spiral valve. The sexes pair regularly, the females having oviducts highly organized, which supply the place of a matrix in those that bring both their young alive; such as produce eggs have them with a horny covering, the substance of which is supplied by a larger gland surrounding the oviduct. The males are easily known by large appendages on the inner edge of the ventrals, the use of which is not well known, [though believed to serve as *claspers*].

Squalus, the Sharks properly so called, have a long body; a thick, fleshy tail; moderate pectorals; and resemble ordinary fishes in their form, having the gill-openings on the sides of the neck, not below, as in the Rays, and the eyes in the sides of the head. The snout is supported by three cartilaginous branches arising from the fore part of the cranium, and the rudiments of maxillaries, intermaxillaries, and premandibulars, may be traced in the skeleton. The bone of the shoulder is suspended in the muscles behind the gills, without connexion with the cranium or the spinal column. Some are viviparous; others produce eggs covered with yellow and transparent horn, of an oblong shape, and with cords of horn at the angles. Their small gill-ribs are apparent, and small ones are traceable along the spine; their flesh is dry and leathery, and eaten only by the poor. They are numerous, and form many subgenera.

Scyllium (called Dog-fishes on the British coast).—Snout blunt and short; nostrils near the mouth, continued in a groove to the edge of the lip, and more or less closed by membranes; teeth with a long point in the middle, and a shorter one at each side. They all have spiracles, and one anal fin; the dorsals are far backward, the first being even before the ventrals; their caudal is long and truncated, and their gill-openings under the pectorals in the British ones; the anal is against the interval between the two dorsals. The species are:

S. canicula, the Small-spotted Dog-fish, with numerous spots and the ventrals truncated.—*S. cutilis*, the Large-spotted Dog-fish, with the spots larger, sometimes ocellated, and the ventrals square.—*S. melastomum*, Black

mouthed Dog-fish. Light-brown, with ocellated spots. All the three are peculiarly destructive to the more valuable fishes. Some foreign ones have a slight difference of character.

The Sharks properly so called include all species with a produced snout, no nasal grooves, and with a caudal lobe more or less forked. They form the genus

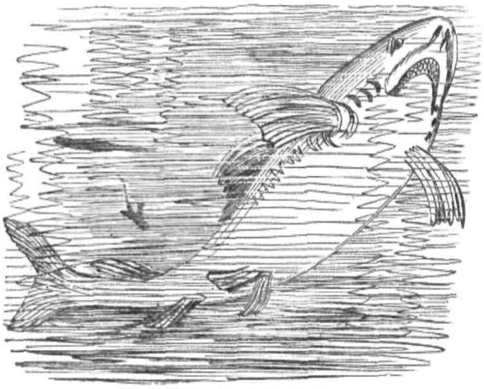

Fig. 147.— The White Shark.

Carcharias,—a numerous and notorious tribe, with trenchant-pointed teeth, usually serrated in the margins; the first dorsal before the ventrals; the second nearly opposite the anals. They have no spiracles; the nostrils are in the middle of the snout, and the last gill-opening extends over the pectorals. *C. vulgaris*, the White Shark, is sometimes twenty feet long, with isosceles-triangular teeth, ragged at the sides, and the lower ones narrow points placed on wider bases; these teeth in the mouth of such a fish forming weapons dreaded by all mariners. Found in most seas. [Its appearance on the British shores has been mentioned, but it wants authentication.] *C. vulpes*, the Fox-shark, or Thresher.—Triangular teeth in both jaws; upper lobe of the tail as long as the whole body; second dorsal and anal very small. *C. glaucus*, the Blue Shark, with curved-sided teeth above, inclining outwards, and straighter ones below; all ragged on the edges.

Lamna, the Porbeagle, differs from a true Shark in the pyramidal snout, and the gill openings before the pectorals. *L. cornubica* occasionally appears on the British coast, and its size has caused it to be mistaken for the White Shark. *L. monensis* resembles the last, but has the snout shorter.

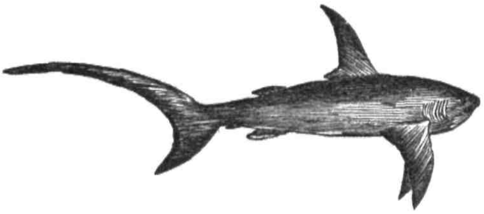

Fig. 148.—The Thresher.

Galeus.—Shaped like the Sharks, but with spiracles and an anal. *G. vulgaris*, the Tope, is found on the British shores.

Mustelus, resembles the former in shape, but has the teeth like a close pavement.

Milavis, the Smooth Hound, is a British species.

Notidanus, wants the first dorsal; has six gill-openings, triangular teeth above, and like a saw below. Two species inhabit the Mediterranean. Has the form of the Sharks, and spiracles, with the gill-openings nearly surrounding the neck; its teeth are small and not notched. It is the largest of the True Fishes, being sometimes thirty-six feet long; but it is a harmless fish. *S. maximus*, the Basking Shark, is found in the British seas.

Centracion, has spiral teeth like pavement, and a spine before each dorsal.

Spinax, resembles Carcharias, but has spiracles; no anal fin; several rows of small trenchant teeth; and a strong spine before each dorsal. *S. acantheus*, the Piked Dog-fish, is a British species.

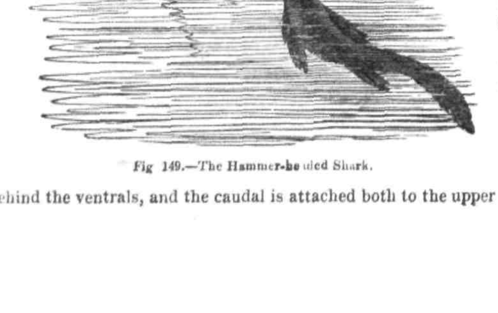

Fig 149.—The Hammer-headed Shark.

Centrina, resembles the last; but the second dorsal over the ventrals, and the short tail, give it a clumsy appearance; its skin is very rough.

Scymnus, the Greenland Shark, is more abundant in the Arctic seas, and is large and voracious; but is understood not to attack Man.

Zygœna, forms a second genus. Like the Sharks in the body, but with the snout singularly produced, forming two pieces like a double-headed hammer, with an eye in the middle of each extremity. The species of the European seas grow to the length of twelve feet, [and we believe larger ones are met with in southern latitudes].

Squatina, the Angel Fish, has spiracles and wants the anal; but it has the mouth at the end of the muzzle; the eyes in the upper part of the head; the head round; the body broad and flattened horizontally; the pectorals large and far forward, but separated from the back by a slit in the gill-openings; their two dorsals are behind the ventrals, and the caudal is attached both to the upper and under sides of the termination of the body.

S. angelus, the Common Angel-fish, grows seven or eight feet long; is very voracious, and one of the ugliest of fishes.

Pristis, the Saw-fish, form a fourth genus. They have a long body, like the Sharks, with the gill-openings below; the snout extended like the blade of a sword, and with strong and trenchant teeth like spines on both edges. This formidable weapon gives name to the fishes, and with it they will attack the largest Whales, and inflict dreadful wounds. They sometimes attain twelve or fifteen feet in length.

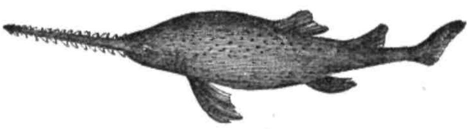

Fig. 150.—The Saw-fish

Raia, the Skate, [or rather, perhaps, *Raiaidæ*, the Skate family,] are less numerous than the Sharks. They have the body flattened till, from its union with the large and fleshy pectorals, it forms a disc. These pectorals are joined to each other before the snout; extend behind as far as the base of the ventrals, and have their humeral bones articulated with the spine behind the gills. Eyes and spiracles above; mouth, nostrils, and gill-openings below; and dorsal fins almost always on the tail. Eggs brown, leathery, and square, with points at the angles. They consist of the following subgenera:

Rhinobatis, connect the Sharks and Rays by their thick fleshy tail, and two distinct dorsals and a caudal. The rhomboids formed by the snout and pectorals is sharper in front and narrower than in the ordinary Rays; but excepting this they have all the characters of these, and their crowded teeth are placed in fives, like little paving-stones. Some inhabit the Mediterranean; some the Atlantic; and one species from Brazil is said, but not proved, to be electric. *Rhina* differs from Rhinobatis in having a stout, broad, and rounded snout.

Torpedo.—Tail short, but tolerably fleshy; disc of the body nearly circular, the anterior edge being formed by two productions of the muzzle, which extend outwards and join the pectorals. The space between the pectorals and the head and gills is filled by an electric apparatus, consisting of numerous cells formed like honeycombs, and subdivided by lateral diaphragms, in the intervals of which a mucous fluid is contained. This electric or galvanic apparatus is, like that in Gymnotus, amply supplied with nerves. The shocks given by the Torpedo, though smart, are not so benumbing as those of Gymnotus. They probably enable it to stun its prey. The body is smooth, and the teeth small and pointed. Two species, one with ocellated spots, and another with seven fleshy protuberances round the spiracles, with the back marbled, sprinkled, or spotted with brown, were long confounded with this one. There are also several species in the foreign seas. The Common Torpedo is occasionally found on the Channel coast of England.

Raia, the Rays properly so called, or Skate, have the disc rhomboidal; the tail slender; with two small dorsals on the upper part, near the point, and sometimes the vestige of a caudal; and their teeth are small, and ranged in quincunx on the jaws. The European seas furnish many species, some of which are not yet well determined. Their flesh is rather hard when recent, but wholesome. [The species found in the British seas are as follows: *R. chagrinea*, the Shagreen Ray; *R. batis*, the Blue or common Skate; *R. oxyrhynchus*, the Sharp-nosed Ray; *R. marginata*, the Margined Ray; *R. maculata*, the Homelin or Spotted Ray; *R. microcellata*, the Small-eyed Ray; *R. clavata*, the Thornback; and *R. radiata*, the Starry-ray.—*Yarrell's British Fishes.*]

Trygon, the Sting Ray, has on the tail a strong spine notched on both sides; teeth similar to the other Rays; the disc obtuse forwards, and the tail often without any fin save a rudimental membrane. *R. acanthus* resembles Trygon, but has the tail long and slender, without fin or spine.

Miliobatis, the Eagle Ray, has the snout projecting beyond the long pectorals, which extend outwards like wings; the jaws have broad flat teeth like a pavement; the tail is long and slender, having a spine on the upper part near the base, and not far behind the small dorsal. In some there are two or more spines.

Cephaloptera, has the small tail, the spine, and the small dorsal of the last subgenus: but the pectorals are more extended in proportion to the length of the body; the head is truncated in front, and a lobe of each pectoral advances on each side of it, making the fish seem as if it had horns.

THE SECOND FAMILY OF THE CHONDROPTERYGII BRANCHIIS FIXIS.

CYCLOSTOMATA (with the Mouth formed into a Sucker).

With respect to their skeleton these are the least perfect of fishes, and, indeed, of all vertebrated animals. They have no pectorals or ventrals; their body ends in a circular fleshy lip, with a cartilaginous ring supporting it, and formed of the soldered palatals and mandibularies. The substance of all the vertebræ is traversed by a single tendinous cord, filled internally with a mucilaginous fluid, without contractions and enlargements, which reduces the vertebræ to cartilaginous rays not easily distinguishable from each other. The annular portion is rather more solid than the rest, but not cartilaginous through its whole circle. They have no ordinary ribs, but the gill-ribs, noticed as rudimental in the Sharks and Rays, are more developed and united with each other in this family into a kind of cage, but there are no solid gill-arches. Instead of being comb-shaped, as in other fishes, the gills have the

appearance of sacs produced by the union of the faces of the proximate ones. The labyrinth of the ear is embedded in the cranium, and the nostrils opened by a single orifice, in front of which is a blind cavity, improperly thought a spiracle. The intestine is straight and slender, with a spiral valve.

Petromyzon, the Lampreys, have seven gill-openings on each side, and the skin on the upper and under parts of the tail is formed into fin-like crests, which, however, have no rays. The Lampreys properly so called, have strong teeth in the maxillary ring, and the inner disc of the lip, which is very circular, is covered with tubercles, hard and crusted like teeth: this ring is suspended by a transverse plate answering to the intermaxillaries, and there are vestiges of maxillaries on the sides. The tongue, which moves backwards and forwards like a piston, and performs the suction, has two longitudinal rows of small teeth. Water reaches the gills from the mouth by a particular membranous canal, a sort of trachea, placed under the gullet and perforated with holes; there is a dorsal before the vent, and another behind it which unites with the caudal. They habitually fix themselves to stones and other hard substances by means of the sucker; and they attach themselves to the largest fishes in the same manner, and in the end pierce their integuments and prey upon their substance.

The species are—*P. marinus*, the Sea Lamprey, two or three feet long, marbled with brown and a yellow ground; the first dorsal separate from the second; two large teeth on the upper part of the maxillary range. In spring they approach the mouth of rivers, and their flesh is highly esteemed. *P. fluviabilis*, the River Lamprey, from a foot to eighteen inches long; silvery, with blackish or olive spots on the back; two large teeth in the maxillary ring; found in the fresh waters. *P. planerii*, the Small River Lamprey, is eight or ten inches long, and has the colours and teeth of the preceding: it also inhabits the fresh waters. [The last two are often styled Lamperns.]

Myxine.—The members of this genus have but one tooth in the maxillary ring, which is entirely membranous; two rows of strong teeth on each side of the tongue; but in other respects like the Lampreys. The mouth is circular, with eight cirri, and has a spiracle on the upper margin which reaches the interior. The body is cylindrical, and furnished with one fin round the extremity of the tail. The intestine is straight, but simple, and plaited internally, and the liver has two lobes: no eyes are perceptible. Their eggs grow to a large size; they discharge so much mucus from the pores in their lateral line that if kept in a vessel of water they turn it into a jelly; they attack fishes in the same manner as the Lampreys, and they are divided into subgenera according to the number of their gill-openings.

Heptratremus, has seven on each side, like the Lampreys, and the only known species is from the South Sea.

Gastrobanchus, has a common canal to the gills on each side, each of which opens by a hole near the heart, and at one third of the length from the head. *G. glutinosa*, the Hag, is the only known species, and it enters the mouths of fishes when on the fishermen's line, and plunders their substance.

Ammocetes, has the entire skeleton so soft and membranous that there is not a bone in the whole, not even a tooth; they have the external form and gill-openings of the Lampreys, but their fleshy lip forms only a semicircle on the upper part of the mouth, which is furnished with numerous cirri. The known species, *A. branchialis*, is from six to eight inches long, about the thickness of a goose-quill, and of no use but as bait for other fish. [It has been accused of sucking the gills of other fishes, but perhaps falsely. It is found in the sand and mud of small streams; preys on worms, insects, and dead matter, and is, in return, preyed on by the Eel.]

[*Amphioxus*, has the body compressed, the surface without scales, and both ends pointed. It has a dorsal along the whole line of the back, but no other fins. The mouth is on the under side of the body, opens longitudinally, and has a row of filaments on each side. *A. lanceolatus*, the Lancelet, is the only known species. It is a British fish, and an inhabitant of the sea, in which it is found, although very rarely, lurking under stones in pools left by the ebbing tide. Pallas considered it as a molluscous animal, and not a fish; but Mr. Yarrell, in his *British Fishes*, argues that it is a fish, and that in organization it is the lowest of the class. "The form of the fish," says Mr. Yarrell, "is compressed; the head pointed, without any trace of eyes; the nose rather produced the mouth on the under edge, in the shape of an elongated fissure, the sides of which are flexible; from the inner margin extend various slender filaments, which cross and intermingle with those on the opposite side. Along the sides of the body the muscles are arranged in regular order, diverging from a central line; one series passing obliquely upward and backward, and the other series as obliquely downward and backward; the anal aperture is situated one-fourth of the length of the fish in advance of the end of the tail; the tail itself pointed; from the nose to the end of the tail, a delicate membranous dorsal fin extends the whole length of the back, supported by very numerous and minute soft rays; the surface of the body smooth." These characters leave no doubt that the animal is a fish; but that it ought to be classed with the Lamprey family is another matter. The specimen from which the description was made was not above an inch in length, very slender, and almost transparent.]

FIRST DIVISION, FOURTH CLASS.—PISCES

PROFESSORS AGASSIZ AND MÜLLER'S CLASSIFICATION OF FISHES.

THE classification of Fishes proposed by Cuvier has been found to require considerable modification, in consequence of the more complete knowledge since obtained regarding their internal structure; and also, because it is found inapplicable to the arrangement of the numerous extinct forms which Geological research has brought to light. The attentive study of these has suggested to Professor Agassiz a method of arrangement founded upon their *scaly covering*, which affords characters well adapted for an easy subdivision of the class, and which enables us to assign a place with little difficulty to the numerous fossils which the examination of even a single stratum often brings into view; the scales being usually among the best-preserved parts of the entire animal, and being often in a state of perfect preservation, when every part of the internal skeleton has disappeared by decay. As this classification is much in use at the present time, especially amongst those who are engaged in the study of Fossil Fishes, we shall give a brief sketch of it; although, as we shall show, it is far from being perfect. The entire class is divided into the four following orders:—

I. GANOIDEANS; from the Greek γανος, splendour. The fishes of this Order have a complete bony armour, usually covered by a coating of enamel, which gives them a peculiarly lustrous appearance. This armour generally consists of scales of small size, and of angular shape, somewhat overlapping each other, and arranged with great regularity, as in the *Lepidosteus*, or Bony Pike. In other instances, it is composed of plates of large size and irregular shape, with jagged edges that lock together, as in the *Sturgeon*. The former of these fish has a *bony* internal skeleton, and the latter a *cartilaginous* one; and a similar difference appears to have existed among the several extinct tribes of the Order.

II. PLACOIDEANS; from the Greek πλαξ, a *broad plate*. This Order contains the fishes whose skin is covered *irregularly* with plates of hard bony matter, or of enamel; these are sometimes of large size, but are more frequently reduced to small points, as where they form the *shagreen* on the skin of many *Sharks*, and the prickly tubercles of the skin of most *Rays*. In this group, which comprehends the Sharks and Rays and their allies, the skeleton is for the most part cartilaginous.

III. CTENOIDEANS; from the Greek κτεις, (Gen. κτενος), a *comb*. These fishes have scales composed of horny matter, or of bone destitute of enamel, each scale being composed of several layers arranged one beneath another. They are distinguished from those of the next order, in which the structure of the scale is nearly the same, by having the *posterior* edge (that which is directed towards the tail of the fish, and which overlaps the succeeding scale,) beset with projections like the teeth of a comb. The *Perch* may be taken as the type of this Order.

IV. CYCLOIDEANS; from the Greek κυκλος, a circle. The scales of these fish have a rounded form, with smooth and simple edges. The *Carp*, *Salmon*, and *Herring*, are familiar examples of this Order,

If we compare this classification of Agassiz with that of Cuvier, we shall find that the *Cycloid* fishes of the former are for the most part the *Malacopterygii* of the latter; and that the *Ctenoid* fishes of the former are, speaking generally, the *Acanthopterygii* of the latter. Further, the *Placoid* fishes of Agassiz correspond with the principal section of the *Cartilaginous* fishes of Cuvier; the Sturgeons and Chimæræ being alone excepted. The existing *Ganoid* fishes of Agassiz, however, were distributed by Cuvier amongst several different families; and there can be no doubt that, in bringing them together, Agassiz has effected an important improvement in classification, since they present a general correspondence in internal structure, as well as in the nature of their external covering.

The application of this method of arrangement to the various forms of extinct fishes which Geological research has brought to light, has given some extremely curious results; of which a sketch will now be given.— In the first place it may be stated as a general fact, that of the CYCLOID and CTENOID Orders, there are no remains whatever in any formation anterior to the Chalk; and that, consequently, the whole assemblage of *existing* fishes included in those two orders, probably about four-fifths of those now living, had apparently no representative whatever in the more ancient seas. Even in the chalk there seem to have been only two or three of the largest of the existing families, such as the *Herring* and *Salmon* tribes, the *Mackerel* tribe, and the *Perch* tribe, which attained any considerable importance. The others are either but slightly represented at that epoch, and have subsequently increased very considerably, such as the *Eels* and the *Pleuronectidæ*; or first came in during the Tertiary period, such as the *Carps* and the *Mullets*; or present themselves for the first time in our own epoch, which is the case (strange to say) with the large and important *Cod* tribe. Further, no family belonging to these Orders

has disappeared from the ocean subsequently to its first introduction; nor is there any that seems to have undergone any diminution; so that the Ctenoid and Cycloid Orders may be said to be presenting their highest development at the present time.

When we survey the Geological distribution of the other two Orders, however, we see a most extraordinary contrast. Although they now form so small a part of the inhabitants of our seas, we look back to a time when they were the sole Vertebrated tenants of the globe; and we see that in the period anterior to that of the predominance of the great extinct aquatic Reptiles, whose remains abound in the Lias and Oolite formations, certain tribes of each Order had attained a very high degree of importance. Of several families, moreover, which existed in the earlier periods of the history of the globe, some of them even having been the most numerous and important tribes in the whole class as then existing, not a single representative now remains. Of these, the most remarkable among the GANOID fishes is the family of *Lepidoids;* which was characterized by the possession of numerous rows of brush-like teeth, and by the covering of flat rhomboidal scales arranged parallel with the body. Remains of this family present themselves in nearly the oldest fossiliferous strata; it first began to abound, however, in the Carboniferous period; attained its fullest development in the period of the Triassic formation; slightly diminished during the Jurassic period; underwent a still greater diminution during the deposition of the Chalk; and disappeared completely in the Tertiary epoch. Scarcely less remarkable is the history of the family of *Sauroid* fish, so named from the numerous points of resemblance to Saurian reptiles, which occur in their internal structure. This family seems to have commenced somewhat later than the preceding, but to have attained its fullest development at about the same part of the series. Its existence, however, has been continued downwards to the present time; though it is now represented by only two genera, both of them restricted to fresh water,—viz. the Polypterus, an inhabitant of the rivers of Western Africa, and the Lepidosteus, a tenant of the rivers and lakes of North America.

In the PLACOID Order, the family of *Cestracionts* corresponds very closely in its history with the Sauroid and Lepidoid Ganoideans. This family bears a general resemblance to the Sharks in the form of the body and in internal structure; but the teeth, instead of being sharp and lancet-shaped, are flat and pavement-like, adapted for crushing instead of for cutting. Remains of Cestraciont fish are among the earliest that present themselves in the Palæozoic rocks; the family increased in importance through the Carboniferous series, and attained its greatest development in the Triassic; after which it progressively diminished, and is now represented by only a single species, the Cestracion Philippi, or Port Jackson Shark.

The families of GANOID and PLACOID fishes, which are *now* most numerous, may, for the most part, be traced backwards to the remoter epochs. Thus the *Sturgeons* and the *Rays* have existed, nearly in the same proportion as at present, from the beginning of the Lias formation; the *Chimæroid* fish date from the commencement of the Secondary period; whilst the *Squaloids*, or true Sharks, make their first appearance in the seas of the Carboniferous epoch, and have been gradually increasing in importance down to the present time. It is very instructive to compare the present predominance of these sharp-toothed Sharks, with the former high development of the Cestracionts or blunt-toothed Sharks; and to note how closely the gradual increase of the one tribe corresponds with the decrease of the other. When we view these facts in connection with the general condition of the class at each epoch, we find the explanation of it perfectly easy; for the period of highest development of the Cestraciont family was that at which nearly all other existing fish were of the Ganoid order; that is, were covered with an armature of bony or enamelled scales or plates, quite impenetrable to any simple *cutting* instrument, and requiring powerful *crushing* teeth to make any impression upon them; whilst, on the other hand, it is only since the introduction of the Ctenoid and Cycloid fish, whose thin horny scales present no such impediment, that we find the family of sharp-toothed Sharks, to which they furnish appropriate food, rising into importance.

Omitting from the Ganoid Order the Siluroid family, which more properly belongs to the Cycloids, and omitting from the Placoid Order the Cyclostome fish, which cannot be appropriately ranged under any one of the primary divisions of Professor Agassiz, it may be stated as a general fact, that all the existing GANOID and PLACOID fishes are representatives of families, whose first appearance dates back at least as far back as the commencement of the Tertiary epoch, most of them being of much older date. The principal development of these Orders shows itself in the Palæozoic and Secondary periods, that is, during the formation of all rocks older than the Chalk; and the class being then entirely destitute of Ctenoid and Cycloid fishes, must have possessed, as a whole, a very different aspect from that which it now presents.

Another general fact of much scientific interest is brought into view by the study of the fishes of the older Geological formations. In all the Ctenoid and Cycloid fishes, the caudal fin is equally expanded above and below, and commences from the end of the vertebral column, which does not pass into it. This form of tail is called by Professor Agassiz, the *homocercal* tail. But in the Sharks, Sturgeons, and Lepidosteus of the present time, we find the caudal fin composed of two unequal branches, of which the upper one is supported upon a prolongation of the vertebral column, whilst the lower and shorter is given off from its under side. This form of tail is called the *heterocercal*. All the earlier Placoid and Ganoid fish seem to have possessed this latter form of tail; the homocercal confirmation not manifesting itself until after the commencement of the Secondary period. Both varieties present themselves in the Sauroid and Lepidoid fish; the heterocercal in the older, and the homocercal in the more recent. It is a curious fact that *all* fishes have the heterocercal character of tail at an early period of their embryonic development; so that this may be considered as the more *general* form, which gives place, in certain cases, to one more specially adapted to the conditions of their existence.

Although the classification of Professor Agassiz has thus been of the greatest service to the Geologist, and was a great advance upon that of Cuvier as regards its adaptation to the reception of the extinct forms of the class, it has the faults to which all classifications that are based on *single* characters are liable; dissimilar tribes being,

brought together, and tribes that are really allied being widely separated. The following classification, which is that of Professor Müller, slightly modified by Professor Owen, being founded on the *general organization* of the animals it includes, has more title to be considered a *natural* one, and represents the nearest approach to a perfect arrangement which the present state of knowledge admits.

Order I.—DERMOPTERI.

Internal skeleton unossified; integument and vertical fins muco-dermoid; vermiform, or abrachial and apodal, no pancreas, no air bladder.

Sub-order 1. Pharyngobranchii, (or Cirrhostomi.) Gills free, pharyngeal, inoperculate; no heart.

Family.—Amphioxidæ. *Example.*—Lancelet.

Sub-order 2. Marsipobranchii, (or Cyclostomi.) Gills fixed, bursiform, inoperculate, receiving the respiratory streams by apertures usually numerous and lateral, distinct from the mouth; a heart.

Family.—Myxinoidei. *Example.*—Myxine or Hag. *Family.—Petromyzontidæ.* *Example.*—Lamprey.

Order II.—MALACOPTERI.

Internal skeleton ossified; external skeleton in most as cycloid, in a few as ganoid, scales; fins supported by rays, all, save the first sometimes in the dorsal and pectoral, soft or jointed; abdominal or apodal; gills free, operculate; a swim-bladder and air duct.

Sub-order 1. Apodes.

Family.—Symbranchidæ. *Example.*—Cuchia. *Family.—Murænidæ.* *Example.*—Eel.
Family.—Gymnotidæ. *Example.*—Gymnotus.

Sub-order 2. Abdominales.

Family.	Example.	Family.	Example.
Heteropygii.	Amblyopsis.	*Galaxidæ.*	Galaxias
Clupeidæ.	Herring.	*Esocidæ*	Pike.
Salmonidæ.	Salmon.	*Mormyridæ*	Mormyrus.
Scopelidæ.	Saurus.	*Cyprinodontidæ*	Umber.
Characini.	Myletes.	*Cyprinidæ*	Carp.

Family.—Siluridæ *Example.*—Sheat Fish.

Order III.—PHARYNGOGNATHI.

Internal skeleton bony; external skeleton in some as cycloid, in others as ctenoid, scales; inferior pharyngeal bones coalesced; swim-bladder without duct.

Sub-order 1. Malacopterygii.

Family.—Scomber-esocidæ. *Example.*—Saury-pike.

Sub-order 2. Acanthopterygii.

Family.—Chromidæ. *Example.*—Chromis. *Family.—Cyclo-Labridæ.* *Example*—Wrasse.
Family.—Cteno-Labridæ. *Example.*—Pomacentrus.

Order IV.—ANACANTHINI.

Internal skeleton ossified; external skeleton in some as cycloid, in others as ctenoid, scales; fins supported by *flexible or jointed rays; ventrals beneath the pectorals, or none; swim-bladder without air duct.*

Sub-order 1. Apodes.

Family.—Ophididæ *Example.*—Ophidium.

Sub-order 2. Thoracici.

Family.—Gadidæ. *Example.*—Cod *Family.—Pleuronectidæ.* *Example.*—Plaice.

Order V.—ACANTHOPTERI.

Internal skeleton ossified; external skeleton as ctenoid scales; fins with one or more of the first rays unjointed or inflexible spines; ventrals in most beneath, or in advance of the pectorals; swim bladder without duct.

Family.	*Example.*	*Family.*	*Example.*
Percidæ.	Perch.	*Squamipennes.*	Chætodon.
Sclerogenidæ.	Gurnard.	*Tænioidei.*	Riband-fish.
Sciænidæ.	Maigre.	*Theutyidæ.*	Lancet-fish.
Labyrinthibranchii	Anabas.	*Fistularidæ.*	Pipe-mouth-fish.
Mugilidæ.	Mullet.	*Gobiidæ.*	Goby, Remora, and Lump-fish
Notacanthidæ.	Notacanth.	*Blenniidæ.*	Blenny and Wolf-fish.
Scomberidæ.	Mackerel.	*Lophiidæ.*	Angler.

Order VI.—PLECTOGNATHI.

Internal skeleton partially ossified; external skeleton as ganoid scales or spines; maxillaries and pre-maxillaries fixed together; swim-bladder without air ducts.

Family.—Balistinæ. *Example.*—File-fish. *Family.—Ostraciones.* *Example*—Trunk-fish.
Family.—Gymnodontes. *Example.*—Globe-fish

ORDER VII.—LOPHOBRANCHII.

Internal skeleton partially ossified; external skeleton ganoid; gills tufted; opercular aperture small; swim-bladder without air duct.

Family.—Hippocampidæ. *Example.*—Sea-horse. *Family.—Syngnathidæ.* *Example.*—Pipe-fish.

ORDER VIII.—GANOIDEI.

Internal skeleton in some osseous, in some cartilaginous, in some partly osseous partly cartilaginous; external skeleton ganoid; fins usually with the first ray a strong spine; a swim-bladder and air duct.

Family.	Example.	Family.	Example.
Salamandroidei.	Lepidosteus. Polypterus.	*Sturionidæ.*	Sturgeon.
		Acanthodei.	Acanthodes.
Pycnodontidæ.	Pycnodus.	*Dipteridæ.*	Dipterus.
Lepidoidei.	Dapedius.	*Cephalaspidæ.*	Cephalaspis.

ORDER IX.—PROTOPTERI.

Internal skeleton partly osseous, partly cartilaginous; external skeleton as cycloid scales; pectorals and ventrals as flexible filaments; gills filamentary, free; no pancreas; swim-bladder as a double lung, with air duct, intestine with a spiral valve.

Family.—Sirenoidei. *Example.*—Lepidosiren.

[*N B.*—This curious animal, for the reception of which this order has been constituted, combines in a very remarkable degree the characters of the Fish and of the Reptile, and has been placed by many naturalists in the latter class.]

ORDER X.—HOLOCEPHALI.

Internal skeleton cartilaginous; external skeleton as placoid granules; most of the fins with a strong spine for the first ray; ventrals abdominal; gills laminated, attached by their margins; a single external gill aperture; no swim bladder; intestine with spiral valve.

Family.—Chimæroidei. *Example.*—Chimæra. *Family.—Edaphodontidæ* *Example.*—Edaphodon.

ORDER. XI.—PLAGIOSTOMI.

Internal skeleton cartilaginous, or partially ossified; external skeleton placoid; gills fixed with five or more gill apertures; no swim bladder; scapular arch detached from the head; ventrals abdominal; intestine with spiral valve.

Family.	*Example.*	*Family.*	*Example.*
Hybodontidæ.	Hybodus.	*Squatinæ.*	Monk-fish.
Cestraciontidæ.	Cestracion.	*Zygænidæ.*	Hammerhead-shark.
Notodanidæ.	Gray-shark.	*Pristidæ.*	Saw-fish.
Spinacidæ.	Piked Dog-fish.	*Rhinobatidæ.*	Rhinobates.
Scylliidæ.	Spotted Dog-fish.	*Torpedinidæ.*	Electric-ray.
Nictitantes.	Tope.	*Raiidæ.*	Ray, or Skate.
Lamnidæ.	Porbeagle.	*Trygonidæ.*	Sting-ray, or Fireflaire.
Alopeciidæ.	Fox-shark.	*Myliobatidæ.*	Eagle-ray.
Scymniidæ.	Greenland-shark.	*Cephalopteridæ.*	Cephaloptera.

The additional information recently gained respecting the curious little *Amphioxus* or Lancelet (p. 334), has left no doubt as to its claim to be regarded as a fish; but its peculiarities of organization are such as to separate it completely from all other members of the class. The nervous system consists almost solely of a spinal cord, with scarcely any traces of a brain or of organs of sense; and this is enclosed in a fibrous sheath, the only representative of the vertebral column. This sheath, with a series of fine transparent threads of cartilage on either side, representing the ribs, and with a framework around the pharynx, constitutes the entire skeleton; of a proper cranium there is not the slightest vestige. The blood is colourless, like that of Invertebrata; and instead of a single heart for its propulsion, we find numerous bulb-like enlargements scattered over the system of blood-vessels, reminding us of the circulating apparatus amongst the inferior Worms. The water which is taken in for respiration, and which passes through the slits in the dilated pharynx, is not thence transmitted directly outwards through the gill-chambers by orifices in the neck; but is sent into the general cavity of the abdomen, from which it finds its way out by a single aperture, the "abdominal pore." This arrangement closely corresponds to that which exists in the Ascidian Mollusks. The alimentary canal is lined with cilia; there is no distinct trace of a liver. Thus the Lancelet is quite isolated from all other existing fishes; being removed even from the group of Cyclostomi to which it is most nearly allied, by differences which are greater than those which separate fishes from some of the Batrachian Reptiles. Perhaps we are to regard it as a relic of some order of fishes now all but extinct, which, in consequence of the softness of their skeletons, have left no fossil traces of their existence.

SECOND GREAT DIVISION OF THE ANIMAL KINGDOM.

THE MOLLUSCA. *

THE MOLLUSCA have no articulated skeleton nor vertebral canal. Their nervous system does not unite in a spinal cord †, but merely in a certain number of medullary masses dispersed in different points of the body, the principal one of which, called the brain, is placed crosswise upon the gullet, encircling it with a nervous collar. Their organs of motion and of the senses have not the same uniformity in number and position as in the Vertebrated Animals; and the variety is still more striking with the viscera, particularly in relation to the position of the heart and respiratory organs, and even in the structure and nature of the latter; for some Mollusca breathe the free air, and others the fresh or salt water. In general, however, their external organs, and those of locomotion, are symmetrical on the opposite sides of a middle axis.

The circulation of the Mollusca is always double,—that is to say, their pulmonary circulation always makes a separate and complete circuit; and this function is always aided by one fleshy ventricle at least, placed, not as in the Fishes, between the veins of the body and the arteries of the lung, but, on the contrary, between the veins of the lung and the arteries of the body. It is, consequently, an aortic ventricle. The family of Cephalopods alone is provided, besides, with a pulmonary ventricle, which is even divided into two. The aortic ventricle is also divided in some genera, of which the *Arca* and *Lingula* are examples : at other times, as in the remaining bivalves, its auricle only is divided.

When there is more than one ventricle, they are not united together to form a single organ, as in animals with warm blood, but they are often placed considerably apart, so that we may say that then there are several hearts.

The blood of the Mollusca is white, or bluish ; and the fibrine appears to be proportionally less abundant than in the blood of Vertebrated Animals. There is reason to believe that their veins perform the functions of absorbent vessels.

Their muscles are attached to different points of their skin, and form there tissues more or less complicated and close in texture. The motions of these tissues are limited to contractions in different directions, which produce inflexions and prolongations, or relaxations, of their different parts; by means of which the creatures creep, swim, and seize upon various objects, according as the forms of the parts are adapted to these movements ; but as their members are not sustained by jointed and solid levers, the Mollusca cannot make rapid springs.

The irritability of the greater number of the Mollusca is very great, and is retained

* In the original, there is here a long note, containing an exposition of the Linnæan classification of avertebrated animals, and also the modification of it proposed by Bruguières. Cuvier's first sketch of the arrangement now to be explained was made in May 1795.—ED

† From this mode of expression, we infer that Cuvier had adopted the theory, that the brain and spinal cord are the result of a union of the nerves, trending from the circumference to certain centres. The opposite opinion was that maintained by Haller, and all the earlier physiologists.—ED.

a long time in parts after they have been amputated. Their skin is naked, very sensitive, and, in general, bedewed with a humour, which oozes from its pores. No peculiar organ of smell has yet been discovered, although they enjoy that sense; and it may be that the entire skin is its seat, for this has much resemblance to a pituitary membrane. All the Acephales, the Brachiopods, the Cirrhopods, and some of the Gasteropods and Pteropods, are destitute of eyes; but the Cephalopods possess these organs, with a structure equal, at least, in complexity, to those of animals with warm blood. They also are the only Mollusca in which organs of hearing have been detected, and in which the brain is inclosed in a particular cartilaginous skull.

Nearly all the Mollusca have a developement of the skin which covers the body, and resembles more or less a *cloak*, but which is often reduced into a simple disk, or is folded into a tube, or hollowed into a sac, or, lastly, extended and divided in the form of fins or swimmers.

We call those Mollusca *naked* in which the cloak is simply membranous or fleshy; but there is commonly formed within it one or several laminæ of a more or less solid substance, which is deposited in layers, and increases at the same time in extent, as well as in thickness, because the recent layers always extend beyond the older ones.

When this substance lies concealed in the cloak, common usage allows us to extend to the species so circumstanced, the title of *naked Mollusca*. But oftener that substance assumes such a size and developement that the animal can contract or withdraw under its shelter; we then give it the name of *shell*, and the animal is said to be *testaceous*. The skin which covers the shell is thin, and sometimes dried, or wanting: it is commonly called [by French naturalists], the *drap-marin*, [and by the English, and those who write in the Latin tongue, the *epidermis*].*

The variety in the forms and colour, in the exterior sculpture, composition, and lustre of shells, is infinite. The greater number by far are calcareous; there are some simply corneous; but all are formed of material deposited in layers, or exuded by the skin under the epidermis, as are the rete mucosum, the nails, the hair, the horns, the scales, and even the teeth. The texture of shells differs according as that exudation is made in parallel layers, or in vertical filaments arranged closely against each other. †

The Mollusca present every kind of mastication and deglutition: their stomachs are sometimes simple, sometimes multiplicate, often furnished with peculiar armatures, and their intestines are variously elongated. They have, in general, salivary glands, and always a liver of considerable size, but no pancreas‡ nor mesentery. Several have secretions, which are peculiar to them.

They exhibit, also, every variety of generation. Several fecundate themselves, while in others, although hermaphrodite, the union of two individuals is necessary to fecundation: in many the sexes are distinct and separate. Some are viviparous; others are oviparous, and the eggs of these are sometimes enveloped in a more or less consistent shell, or sometimes only in a simple viscosity.

These variations in digestion and generation are found in Mollusca of the same order, sometimes of the same family.

The Mollusca, in general, seem to be animals of inferior developement: hebetous

* Previous to my system, the Testacea were considered a peculiar order; but the transitions from the naked to the shelled Mollusca are so insensible, and their natural divisions are so interlaced, that this *distinction can be no longer retained. Moreover, there are several* Testacea which are not Mollusca.

† The student will find the formation of shells, and their structure, admirably explained by Mr. Gray, in a paper on the economy of Molluscous animals, inserted in the *Phil. Trans.*, 1833.—ED.

‡ *Professor Grant maintains that there is a* pancreas, or its representative, in all classes of Mollusca.—ED.

and incapable of active exertion, they maintain themselves amid living beings principally by their fecundity, and the tenacity with which they retain life.

DIVISION OF THE MOLLUSCA INTO SIX CLASSES.*

The general form of the body of the Mollusca being, in a sufficient degree, proportional to the complication of their internal organization, indicates their natural divisions.

In some, the body has the form of a sac, inclosing the branchiæ, and open above, whence there protrudes a head well developed, and crowned with certain strong fleshy elongated productions, by means of which the animals progress, and seize upon objects. We call these the CEPHALOPODES.

In others, the body is not open; the head has no appendages, or only very minute ones; the principal organs of locomotion are two wings, or membranous fins, placed on the sides of the neck, and in which the branchial tissue is often spread. These are the PTEROPODES.

Others, again, crawl on the belly on a fleshy disk, sometimes, though rarely, compressed into a fin. They have almost all a distinct head. We call these the GASTEROPODES.

A fourth class is composed of those Mollusca in which the mouth lies concealed in the base of the cloak, which also incloses the branchiæ and the viscera, and opens either throughout its whole length, or at both its extremities, or at one only. These are our ACEPHALES.

A fifth comprehends the species which, inclosed also in a cloak, and without an apparent head, have fleshy or membranous arms, garnished with ciliæ of the same nature. We have called these the BRACHIOPODES.

Lastly, there are some which, alike the other Mollusca in the cloak, the branchiæ, &c., differ from them in having numerous horny articulated members, and in a nervous system more allied to that of the Annulose Animals. Of these we constitute our last class, the CIRRHOPODES.

THE FIRST CLASS OF MOLLUSCA.

THE CEPHALOPODES.†

The cloak unites under the body, and forms a muscular sac, that incloses all the viscera. In several species, its sides are extended into fleshy fins. The head issues from the opening of the sac: it is roundish, furnished with two large eyes, and crowned with fleshy conical arms or feet, varying in their length, and capable of being bent very vigorously in every direction; and, as their surface is armed with suckers, the animals fix themselves, by their means, with great force to whatever objects they embrace. With their feet they seize their prey, walk, and swim. They swim with the head backwards, and crawl in all directions, with the head beneath and the body above.

* For the name *Mollusca*, M. de Blainville proposes to substitute *Malacozoa*; and he separates from them the Chitons and the Cirrhopods, with which he makes a subtypical section under the name *Malentozoaria*. The following distribution of the Mollusca into classes is entirely my own, as well as the greater number of the sub divisions to the second degree.

† The *Cephalophora* of De Blainville.

A fleshy funnel placed at the aperture of the sac, before the neck, affords an outlet to the excretions.

The Cephalopodes have two branchiæ, one on each side of the sac, in the shape of a compound fern-leaf. The great vena cava, when between them, divides into two branches, which terminate each in a fleshy ventricle, placed at the base of its respective branchia, and propelling the blood into it.

The two branchial veins tend to and terminate in a third ventricle, situated near the bottom of the sac, whence the blood is carried to every part of the body by different arteries.

Respiration is effected by the water which enters into the sac, and is driven out again through the funnel. It appears that the water even penetrates into two cavities of the peritoneum, which the venæ cavæ cross in their course to the branchiæ; and that it has some influence on the venous blood, through the medium of a glandular apparatus attached to these veins.

The mouth opens amidst the bases of the feet. It has two powerful corneous jaws, similar to the beak of a Parrot, and between the jaws is a tongue roughened with horny prickles. The gullet swells out into a crop, and then passes into a gizzard as fleshy as that of a bird, to which succeeds a third membranous and spiral stomach, into which the liver, which is very large, pours its bile through two conduits. The intestine is simple and short. The rectum opens into the funnel.

These animals have a peculiar excretion of a deep black colour, which they use to taint the water when concealment is necessary. It is secreted by a gland, and reserved in a sac, differently situated in different species.

Their brain, inclosed in a cartilaginous cavity of the head, sends off from each side a cord which swells, within each orbit, into a large ganglion, whence are derived innumerable optic filaments. The eye is formed of numerous membranes, and is covered by the skin, which becomes transparent in passing over it, and sometimes forms folds that supply the want of eyelids. The ear is merely a little cavity excavated on each side near the brain, without semicircular canals or external passages, and in which there is suspended a membranous sac, containing a little stone.

The skin of these animals, particularly of the Octopus, changes colour, in patches and in spots, with a rapidity greatly superior to that of the Chameleon.*

The sexes are separate. The ovary of the female is at the bottom of the sac. Two oviducts carry the eggs from it, passing them through two large glands which envelope them, during their passage, with a viscous fluid, and gather them together into a sort of cluster. The testicle of the male, similar in position to the ovary, gives off a vas deferens that terminates in a fleshy penis situated to the left of the anus. A vesicula seminalis, and a prostate, also open there. There is reason to believe that impregnation is effected by a sprinkling of the seminal fluid over the eggs, as illustrated in the majority of Fishes. In the season of spawning, the vesicula contains a vast number of little filiform bodies, which, through a peculiar mechanism, writhe and move about rapidly as soon as they fall into the water, and shed the fluid with which they are filled.

These animals are voracious and savage; and as they are agile, and are furnished

* See Carus, *Nov Act. Nat. Cur.* xii. part i. p. 320; and Sangiovanni, *Ann des Sci. Nat.* vol. xvi. p. 308. [Also Coldstream, in *Edinburgh Journ. of Nat. and Geograph. Science*, vol. ii. p. 296.]

with numerous organs for seizing their prey, they destroy many Fishes and Crustaceous animals.

Their flesh is eatable. Their inky secretion is employed in painting, and from it some have asserted that the China ink of commerce is manufactured.*

The Cephalopods comprise only one order†, which we divide into genera from the nature of the shell. Those which have no external shell formed, according to Linnæus, the single genus

SEPIA, OF CUTTLE-FISH,‡

which we now subdivide as follows:—

THE POULPES (*Octopus*, Lam.); the *Polypus* of the ancients.

These have only two small conical grains of a horny substance imbedded in their back, one on each side; and their sac, having no fins, represents an oval purse. Their feet are eight in number, all nearly of equal size, very large in proportion to the body, and united together at their insertions by a membrane. The Octopus uses them equally in swimming, in creeping, and in seizing its prey. From their length and strength they are formidable weapons, by means of which the prey is entangled and caught; and they have often been the destruction of swimmers.§ The eyes are proportionally small, and the skin can be made at will to contract over them so as to cover them completely. The ink bag is embedded in the liver. The glands of the oviducts are small.

Some (the *Polypes* of Aristotle) have their suckers in two alternating rows along [the oral margin] of each foot. The common species (*Sepia octopodia*, Linn.), with a minutely granulous skin, arms six times as long as the body, and garnished with 120 pairs of suckers, infests our coasts in summer, where it destroys an immense quantity of Crustacea. The seas of the tropics produce the *Octopus granulatus*, Lam. (*Sepia rugosa*, Bosc.) *Séb.* iii. ii. 2, 3, known by its more decidedly granulated body, its arms only a little longer than itself, garnished with fifty pairs of suckers. Some believe this to be the species which furnishes the China ink of commerce.

Other Poulpes (the *Eledons* of Aristotle) have only a single row of suckers down each foot. In the Mediterranean there is a species remarkable for its musky smell: it is the *Octopus moschatus*, Lam.—*Mém. de la Soc. d'Hist. Nat.* in 4to, pl. 11; *Rondelet*, 516.

THE ARGONAUTS (*Argonauta*, Linn.)—

Are Poulpes with two rows of suckers: the pair of feet nearest the back expand, at their extremities, into a broad membrane. They have not the dorsal cartilaginous spicula of the common Octopus; but we always find these Cuttles in a very thin, regularly-grooved spiral shell, which, from the disproportionate size of the last whorl, has some resemblance to a canoe, the spire representing the poop. The animal uses it too as a boat, for when the sea is calm, groups of them have been seen navigating the surface in it, employing six of their tentacula for oars, and raising, it is said, the two with expanded extremities to serve the purposes of sails. If the waves rise, or any danger threatens, the Argonaut withdraws all its arms into the shell, contracts itself there, and descends to the bottom. Its body does not penetrate within the spire of the shell, and it appears does not adhere to it, at least there is no muscular attachment, and this fact has led some authors to think that the Cuttle is a parasite of the same nature as the Hermit-crab ‖; but as it is always found in the same shell, as we never find any other animal there, although it is very common, and naturally adapted for rising to the

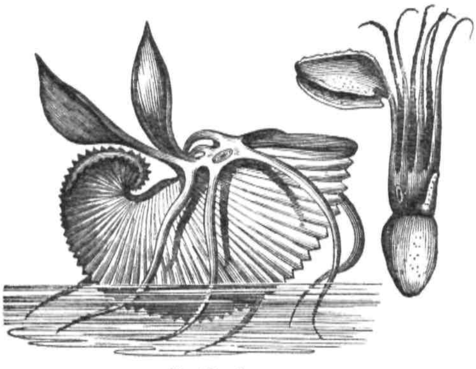

Fig. 151.—Argonauta

* However, M. Al. Remusat has found nothing in Chinese authors to confirm this opinion, [which, the translator may add, is now known to be erroneous].

† The discoveries of Mr. Owen have proved the necessity of dividing the class into *two* orders:—1. DIBRANCHIATA, with two branchiæ, of which all the *naked* Cuttle-fish are examples; and, 2. TETRABRANCHIATA, with four branchiæ, as in *Nautilus*, and as supposed to have been in the multilocular-shelled fossil Cephalopodes.—ED.

‡ In Blainville's system they form the order *Cryptodibranchiata*.

§ This fact needs confirmation; and we need scarcely add, that the stories of their sinking boats and ships are entirely fabulous.—ED

‖ Hence M. Rafinesque, and others following him, have made the animal a genus under the name *Ocythoe*. [Certainly the opinion of its being a parasite was, until recently, entertained by most naturalists but that advocated by Cuvier has been greatly strengthened, or rather proved, by the experiments o Mrs. Power. See the *Mag. of Natural History*, conducted by Mr. harlesworth; and the dissections and arguments of Mr. Owen, in the *Proceedings and Transactions of the Zoological Society of London*. The animal does not sail as here described: the use of the expanded arms is to retain the animal within its shell.]

surface, and as it has been even asserted that the germ of this shell has been seen in the egg of the Argonaut *, we must say that this opinion is, to say the most of it, still very problematical.—Poli, *Testac. Neap.* iii. p. 10. See also Ferussac, *Mem. de la Soc. d'Hist. Nat. de Paris*, ii. p. 160; and Ranzani, *Mem. di Stor. Nat. Lec.* i. p. 85. It is the *Nautilus* and *Pompilus* of the ancients.—*Plin.* ix. c. 29.

We know some species, very like each other both in the animal and shell, which Linnæus confounded together under the name of *Argonauta argo*, vulgarly called the *Paper-nautilus*.

It is supposed that we must ascribe to an animal analogous to the Argonaut, the *Bellerophon*,—fossil shells rolled up spirally and symmetrically, and without septa; but thick, not grooved, and whose last whorl is proportionably shorter. [Sowerby says that Bellerophon is the only fossil that bears any real resemblance to Argonauta, but neither shell, in his opinion, has been formed by a Cephalopodous animal, but probably by one nearly like that of Carinaria. The fossils are characteristic of the carboniferous limestone, and the oldest secondary strata: in these the shell is frequently found changed to silex.]

THE SLEEVE-FISH (*Loligo*, Lam.)—

Have in the back, instead of a shell, a horny lamina in the shape of a sword or lancet. Their sac has two fins; and besides the eight feet, furnished with small pedicled suckers inordinately arranged, their head supports two arms much longer than the feet, and only acetibuleferous near the ends, which are enlarged. These the animal employs as anchors to fix itself. Their ink-bag is buried in the liver; and the glands of their oviducts are very large. They lay their eggs attached together in straight garlands, and in two series; [and the entire mass somewhat resembles a mop, being composed of numerous intestine-like filaments tied together in the centre].

The family is now subdivided from the number and armature of the feet, and the form of the fins. The *Loligopsis*, like the Octopus, has only eight feet, but our knowledge of the genus rests upon figures that are scarcely trustworthy.† In *Loligo* properly so called, the arms have suckers as well as the feet, and the fins are situated towards the end of the sac. We have three species in our seas,—the *L. vulgaris* (*Sepia loligo*, Linn.); *L. sagittata*, and *L. subulata*, or *Sepia media*, Linn. The *Onychotheuthis*, Lichenst. (*Onykia*, Lesueur,) have the form of the Loligo, but the suckers of their arms end in hooked spines. The *Sepiola* have rounded fins, attached, not to the end, but to the sides of the sac. The common Sepiola (*Sepia sepiola*, Linn.) occurs in our seas. The body is short and obtuse, with small circular fins. It never exceeds three inches in length; and its horny lamina is slender and pointed like a needle.‡ The *Sepiotheutes*, Blainv. (*Chondrosepia*, Leukard,) have the sac margined throughout with the fins, as in the Sepia; but their shell is horny, as in the Loligo.

THE CUTTLE-FISH, strictly so called (*Sepia*, Lam.),—

Possess the two long arms of Loligo, and a fleshy fin stretched along each side of their sac. Their shell is oval, thick, tumid, and composed of an infinity of very thin parallel calcareous laminæ, joined together by thousands of little hollow columns, which are placed upright in the spaces between every two laminæ. This structure renders it friable, whence it is employed by artists in polishing various works; and it is given to cage birds to sharpen their beaks upon. The Sepia have the ink-bag separate from the liver, and situated deeper in the abdomen. The glands of the oviducts are enormously large. They deposit their eggs attached to one another in branched clusters, not unlike a cluster of grapes, whence the vulgar have called them *Sea-grapes*.

The species distributed in all our seas (*Sepia officinalis*, Linn.) reaches a foot or more in length. Its skin is smooth, whitish, and dotted with red. In the Indian Ocean there is one with a skin roughened with tubercles (*S. tuberculata*, Lam.). (Among fossils we find some little bodies armed with a spine, which are the ends of a bone of Sepiæ. They constitute the genus *Beloptera* of Deshayes. See *Ann. des. Sc. Nat.* ii. xx. 1, 2. Some other fossils, but petrified, appear to have great relation to the beaks of the Sepiæ. These are the *Ryncholithes* of M. Faure Biguet. —See Gaillardot, *Ann. Sc. Nat.* ii. 485, and pl. xxii.; and D'Orbigny, ib. pl. vi.)

Fig. 152.—Eggs of the Argonaut

Linnæus united in one genus—his

NAUTILUS—

All spirally twisted, symmetrical, and chambered shells,—that is to say, divided by partitions into several cavities; and he supposed them to be inhabited by Cephalopods. One of them is, in fact, the shell of a Cephalopod, very similar to a Sepia, but with shorter arms: it is the genus

SPIRULA, Lam.—

In the hinder part of the body of the Cuttle is an interior shell, which, however dissimilar to the bone of the Sepia in figure, does not differ much from it in the manner of its formation. If we imagine

* This appears now to have been disproved.—ED.

† Loligopsis is now ascertained to have two arms, remarkable for eir great length and gracility.—See Ferussac, in *Ann. des Sciences Nat. Part. Zool.* n. s. iii. p. 339, &c.—ED.

‡ On the anatomy of Sepiola and Loligopsis, consult Dr. Grant's paper in the 1st vol. of the *Zool. Trans.*—ED

that the successive layers, instead of remaining parallel and in nigh approximation, were to become concave towards the body, more distant, each growing a little in breadth, and making an angle between them, we should then have a very elongated cone, rolled up spirally on one plane, and divided transversely into chambers. Such is the shell of Spirula ; which has these additional characters, that the turns of the spire do not touch, and that a single hollow column, occupying the interior side of each chamber, continues its tube with those of the other columns even to the extremity of the shell. This is what is named the *Syphon.*

Only one species (*Nautilus spirula,* Linn.) is known.

The shell of the *Nautilus,* properly so called, differs from that of the Spirula in this,—that the septa increase very rapidly, and that the last turns of the spire not only touch, but envelope the preceding. The syphon is in the centre of each partition. The common species (*Nautilus pompilius,* Lin.) is very large, silvered within, and covered externally with a whitish crust, varied with reddish somewhat undulated bands. According to Rumphius, its animal should be in part lodged in the last cell, and should have the sac, the eyes, the parrot-like beak and the funnel of other Cephalopods; but its mouth, instead of their great feet and arms, should be surrounded with several circles of numerous little tentacula, destitute of suckers. A ligament springing from the beak should run through the syphon, and fix the animal to it. It is probable also that the epidermis is prolonged over the exterior of the shell ; but we may conjecture that it is thin upon such parts as are vividly coloured.*

We meet with specimens of Nautilus (*N. pompilius,* B. Gm. List. 552 ; *Ammonia,* Montf. 74), in which the last whorl does not envelope nor conceal the others, but in which all the whorls, although they touch, are visible,—a character which approximates them to the Ammonites; yet in every other respect they so closely resemble the common species that it is difficult to believe they are not a variety of it.

Among fossils there are Nautili of large and moderate sizes, and of figures more varied than now exist in the ocean.

We also find among fossils certain chambered shells, with simple septa and a syphon, in which the body is at first arched, or even spiral, but the last-formed parts of it are straight : these are the *Lituus* of Breyn, in which the whorls are either contiguous or separate, (the *Hortoles,* Montf.)—Others remaining straight throughout their growth are the *Orthoceratites.* It is not improbable that their animals had some resemblance to that of the Nautilus, or to that of the Spirula.

THE BELEMNITES

Belong, probably, to the same family, but it is impossible to be sure of this, since they are only found in a fossil condition. Their whole structure, however, shows that they were internal shells.† They have a thin and double shell, that is to say, composed of two cones, united at their base, and the interior of which, much shorter than the other, is itself divided internally into chambers by parallel septa, concave on the side that looks to the base. A syphon extends from the summit of the exterior cone to that of the internal cone, and is continued hence, sometimes along the margin of the septa, and sometimes through their centre. The space between the two testaceous cones is filled with a solid substance, composed either of radiating fibres or of conical layers, which envelope each other, and each of which rests on the margin of one of the septa of the inner cone. Sometimes we find only this solid part ; at other times we find also the nuclei of the chambers of the inner cone, or what has been called the alyeolæ. Oftener these nuclei, and even the chambers, have left no other traces behind than some projecting circles within the inner cone ; and in other instances, the alveolæ are found in greater or less numbers, and still piled or strung together, but detached from the double conical case which had inclosed them.

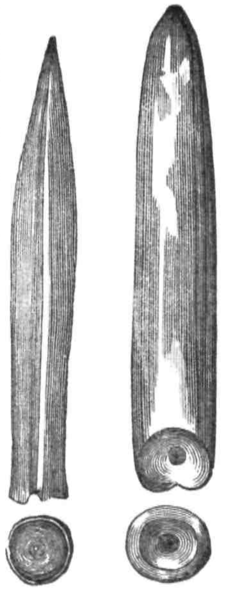

Fig. 153.—Belemnites.

The Belemnites are amongst the most abundant of fossils, particularly in beds of chalk and compact limestone. The most complete works upon them are the *Memoire sur les Belemnites considerées zoologiquement et geologiquement,* by Blainville, Paris, 1827 ; and that of M. I. S. Miller on the same subject, in vol. ii. part 1, of the *Geological Trans.,* Lond., 1826. [The English student will find the fullest details in Buckland's Bridgewater Treatise.] M. de Blainville distributes them from characters derived from the greater or less depth to which the inner cone, or chambered part, penetrates ; from the margins of the external cone, which has, or has not, a small

* The structure of this singular Cephalopod has been fully described and illustrated in a very admirable manner, by Mr. Owen, in his "*Memoir on the Pearly Nautilus,*" Lond., 1832.—ED.

† It may give the student an idea of the nature of the evidence on which fossils are occasionally referred to living types, to mention that Raspail believes the Belemnites to be the cutaneous appendages of some sea animal, perhaps allied to the Sea-urchins, (*Echinus*).—ED.

fissure; from the exterior surface being marked with a longitudinal gutter on one side, or with two or several gutters towards the summit; or as that surface is smooth and without gutters.

Some fossils, very much like the Belemnites, but without a cavity, and even with a protruding basis, form the genus *Actinocamax* of Miller.

It is upon similar conjectures that the classification of the

AMMONITES, Brug., or SNAKE-STONES,—

Is founded, for they, also, are only found in a fossil state. They are distinguished, in general, from Nautilus, by their septa, which, instead of being plain or simply concave, are angulated, sometimes undulated, but oftener gashed on the margins, like the leaves of the Acanthus. The smallness of their last cell leads to the belief that, like the Spirula, they were internal shells. The beds of the secondary mountains swarm with them, and we find them there from the size of a bean to that of a chariot wheel. The variations of their whorls and of their syphon enable them to be subdivided. Thus the name *Ammonites*, Lam., is restricted to the species in which all the whorls are visible. Their syphon is near the margin. They have been still further distinguished into those which have the margins of the septa foliaceous, (the *Ammonites*, the *Planites* of Haan,) and into those in which they are simply angular and undulatory (the *Ceratites* of Haan). Those in which the last whorl envelopes all the others, are the *Orbulites*, Lam., or the *Globites* and *Goniatites* of Haan, or *Peloguses*, Montf. The syphon is the same as in Ammonites.* The name *Scaphites*, Sowerby, [or rather of Parkinson,] has been appropriated to those species whose whorls are contiguous and on the same plane, excepting the last, which is detached and bent upon itself. Those which are perfectly straight are the *Baculites*, Lam. Some are round, others are compressed; and in the latter we sometimes observe the syphon to be lateral. The *Hamites* of Sowerby, [Parkinson,] are known by having their first formed cells arcuated. But the *Turrilites*, Montf., differ more than any from the usual habit of the family, for the whorls, in place of remaining on the same level, descend rapidly, and give to the shell that obelisk form which is denominated turriculated.

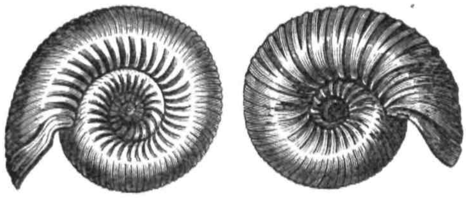

Fig. 154.—Ammonites

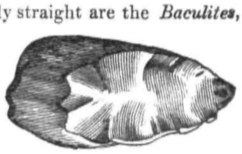

Fig. 155.—Portion of a Baculite

From analogy, it is supposed that we ought to refer to the Cephalopods, and to consider as being internal shells

THE CAMERINES, Brug. (*Nummulites*, Lam.),—

For all of them are equally fossil. They have a lenticular shape, without any apparent aperture, but within there is a spiral cavity, divided by septa into a multitude of little chambers without a syphon. They are amongst the most generally diffused fossils, and almost of themselves form some entire chains of calcareous hills, and immense banks of building stone. (It is upon such rocks that the pyramids of Egypt are founded, and with stones of the same description that they are built.)

The commonest, and which attains the largest size, are altogether discoid, and have only a single row of chambers in the whorl of the spire. Some minute sorts of this description have been also found recent in some seas. Other minute species, both living and fossil, have their margin bristled with points, which give to them the figure of stars (*Siderolithes*, Lam.).

The works and the patient researches undertaken successively by Bianchi (or *Janus Plancus*), Soldani, Fichtel and Moll, and Alex. d'Orbigny, have made known an astonishing number of these chambered and esyphonal shells (*Nummulariæ*), of extreme littleness, so as often to be altogether microscopical, either in the sea, among sand, sea-weed, &c.; or, in a fossil state, in the sand-beds of various countries; and these shells vary to a remarkable extent in their contour, the number and the relative position of their chambers, &c. One or two species, the only ones in which the animals have been noticed, have, apparently, a small oblong body surmounted by numerous red tentacula, a structure which, taken in

* According to Sowerby, *Orbulites* and *Ammonoceras*, of Lamarck, are not distinct from Ammonites. The Ammonoceras is only an accidentally worn portion of an Ammonite.—ED.

connection with the septa of their shells, has occasioned them, like the genera which we have just treated of, to be arranged in the series of Cephalopods; but this classification requires to be confirmed by more numerous observations before it can be considered as settled.* Linnæus and Gmelin placed the species known in their time in the genus Nautilus. M. d'Orbigny, who has studied them more carefully than any one else, makes an order of them, which he calls *Foraminiferes*, because the cells communicate only by holes; and he divides them into families from the manner in which the cells are arranged. When the cells are simple, and disposed spirally, the shells constitute his *Helicostegues*, which are subdivided; for, if the whorls of the spire envelope each other, as is particularly the case with the Camerines, he names them *Helicostegues nautiloides;* if the whorls do not cover themselves, they are *H. ammonoides;* and if the whorls rise up, as in the greater number of univalves, they are his *H. turbinoides*. The family *Stycostegues* is known by the simple cells being, as it were, threaded on a single straight, or slightly curved axis. When the cells are disposed in two alternate rows, they are then the *Enallostegues*. If the cells are gathered together in small numbers, and heaped up in a globular shape, the family is the *Agathistegues*. Lastly, in the *Entomostegues*, the cells are not simple, as in the preceding families, but are subdivided by transverse partitions, so that a section of the shell discovers a sort of trellis-work.

THE SECOND CLASS OF MOLLUSCA.†

THE PTEROPODES.

They swim, like the Cephalopods, in the sea, but cannot fix themselves there, nor creep, from want of feet. Their organs of locomotion consist of fins only, placed at each side of the mouth. The species known are of small size, and few in number. They are all hermaphrodites.

THE CLIO (*Clio*, Linn.; *Clione*, Pall.)—

Have an oblong membranous body, without a cloak; the head is formed of two rounded lobes, whence the little tentacula project; two small fleshy lips, and a tongue, upon the front of the mouth; and the fins contain the vascular network which supplies the place of branchiæ; the anus, and the orifice of generation, are under the right branchiæ. Some have asserted the existence of eyes. The viscera do not nearly fill the exterior envelope. The stomach is large, the intestine short, and the liver voluminous.

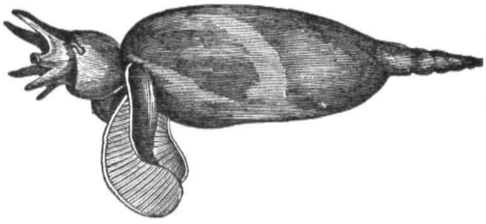

Fig. 156.—Clio borealis

The most celebrated species (*Clio borealis*, Linn.) swarms in the northern seas; and, from its abundance, becomes a food for the Whales, although no individual exceeds an inch in length. Bruguière has observed a larger species, in equal abundance, in the Indian Ocean. It is distinguished by its rose-colour, its emarginate tail, and its body separated into six lobes by as many grooves.

It seems that we must also place here the

CYMBULIA of Peron,—

Which has a cartilaginous or gelatinous envelope in the shape of a boat, or rather of a shoe, roughened with little points arranged in longitudinal rows. The animal has two large vascular wings, which are its branchiæ and its fins; and between them, on the open side, there is a third lesser lobe with three points. The mouth, with two small tentacula, is between the wings, towards the closed side of the shell; and above are two minute eyes, and the orifice of generation, whence issues a penis in the form

* Some of these multilocular shells belong apparently to the testaceous Annelides; while the curious observations of Dujardin seem to have proved that the great bulk of the Foraminiferes are not Mollusca, but animals related to the Infusoria.—*Ann. des Sci. Nat.* n. s. vol. v. et seq.—ED.

† M. de Blainville unites my Pteropodes and Gasteropodes into one class, which he calls *Paracephalophora*, of which my Pteropods constitute his order *Aporobranchiata*. This order he divides into two families:—The *Thecosomata*, which have a shell; and the *Gymnosomata*, which are shell-less.

of a little beak. The transparency of the body allows us to distinguish the heart, the brain, and the viscera, through the envelopes.

THE PNEUMODERMES (*Pneumodermon*, Cuv.)—

Carry their dissimilarity to the Clios a little further. The body is oval, without cloak or shell; the branchiæ attached to the skin, and formed of little leaflets set in two or three lines, disposed in the figure of the letter H opposite to the head; the fins small; the mouth (garnished with two small lips, and two bundles of numerous tentacula, terminated each by a sucker) has underneath a small lobe, or fleshy tentaculum.

The only species (*P. Peronii*, Cuv.) was taken in the ocean by Peron. It is not less than an inch in length.

THE LIMACINÆ, Cuv.,—

Ought, from the description of Fabricius, to have a nigh relationship to Pneumodermon; but their body is terminated with a spiral tail, and is lodged in a very thin shell, of one whorl and a half, umbilicated on one side,* and flat on the other. The shell serves the purpose of a boat; and when the creature wishes to swim on the surface, it uses its fins as oars.

The species known (*Clio helicina* of Phipps and of Gmel.; *Argonauta arctica*, Fabr., *Faun. Greenl.* 387) is not less abundant than the *Clio borealis*, in the Arctic seas; and is likewise a principal aliment of the Whale.

THE HYALES (*Hyalea*, Lam.; *Cavolina*, Abildg.)—

Have two very large wings; no tentacula; a cloak slit on the sides, containing the branchiæ at the bottom of the fissures, and clothed with a shell slit in a corresponding manner, the ventral aspect of which is very tumid; the dorsal aspect is flat, longer than the other, and the transverse line which unites them behind is furnished with three acute denticulations. When alive, the animal protrudes, through the chinks of the shell, certain narrow filaments, or productions of the cloak, of variable lengths.

The best known species (*Anomia tridentata*, Forskahl; *Carolina natans*, Abildgaard; *Hyalea cornea*, Lam.) has a small yellowish semi-transparent shell, and is found in the Mediterranean and the Indian Ocean.

THE CLEODORES (*Cleodora*, Peron).

For these, Brown first instituted the genus Clio. They appear to be analogous to the Hyales in the simplicity of their wings, and the absence of tentacula between them. It is also probable that their gills are concealed in the cloak; but their conical or pyramidal shell is not slit along the margins.

M. Rang distributes the genus into subgenera thus:—*Cleodora*, with the shell pyramidal; *Creseis*, with the shell conical, elongated; *Cuvieria*, with the shell cylindrical; *Psyche*, the shell globular; *Euribia*, the shell hemispherical. (And it is probable that we should arrange near the Creseis, and even perhaps in the same subgenus, the *Tripter* of Quoy and Gaimard, which Blainville has referred to the family Aceræ.)

It has been believed that we may place near to the Hyales,—

THE PYRGO,—

A very small fossil shell discovered by M. Defrance. It is globular, very thin, and divided by a very narrow transverse fissure, excepting in front, where it becomes also a little enlarged.

(Several Pteropodes have been discovered in the fossil state. M. Rang has found, in the *terrains* of Bordeaux, Hyales, Cleodoræ, and Cuvieriæ.—See *Ann. des Sci. Nat. for August* 1826. The *Vaginula* of Daudin is a Creseis, according to Rang; and it has, in fact, all the characters of the same.)

THE THIRD CLASS OF MOLLUSCA.

THE GASTEROPODES.

The Gasteropods constitute a very numerous class, of which the Slug and the Snail give a good general idea. They creep generally upon a fleshy disk, situated under the belly, but which sometimes assumes the form of a furrow, or of a vertical lamina. The back is covered with a cloak of greater or less extent, and of various figure, which secretes a shell in the greater number of the genera. Their head, placed in front, is more or

* Sowerby says, "Umbilicated on both sides."—ED

less distinct, according as it is more or less drawn in under the cloak. It is furnished with tentacula of [comparatively] small size, and which do not encircle the mouth; their number varies from two to six, but they are sometimes wanting; they are organs of touch, and, at most, of smell also. The eyes are very small, sometimes placed upon the head, sometimes at its base, either to a side or at the tips of the tentacula; they are sometimes also wanting. The position, the nature, and the structure of their breathing organs vary, and afford characters whereby to divide them into several families; but they have never more than one aortic heart,—that is to say, one placed between the pulmonary vein and the aorta.

The position of the orifices of the organs of generation, and that of the anus, varies; but they are almost always on the right side of the body.

Several are entirely naked, others have only an interior shell, but the majority are covered with one which contains the soft body, and shelters it.

These shells are secreted in [or on] the cloak. Some of them consist of several symmetrical pieces [or valves]; some of a single symmetrical piece; and others of a non-symmetrical piece, and when this is very concave, or continues to grow for a long time, an obliquely spiral shell is necessarily produced. In fact, that the shell may represent an oblique cone, on which are placed successively other cones always wider in one direction than in the others, it is necessary that the whole should turn to the side which enlarges the least.

That part upon which the cone is turned is named the *columella* [or pillar], and it is sometimes full, and sometimes hollow. In the latter case, its opening is called the *umbilicus*.

The whorls of the shell may remain nearly on the same plane, or they may tend always towards the base of the columella. In this case, the preceding whorls rise above the others as they are formed, and constitute what is called the *spire*, which is acute in proportion to the rapidity with which the whorls descend, and to the measure of their increase. The shells with an elongated spire are said to be *turbinate*. When, on the contrary, the whorls remain depressed on the same level, and do not envelope each other, the spire is *flat*, or even *concave*. These shells are called *discoid*. When the upper part of each whorl envelopes or covers the preceding, the spire is *concealed*.

The place in the shell whence the animal protrudes itself, is named the *mouth*, or *aperture*.

When the whorls remain nearly on the same plane, the animal, in creeping, has its shell placed vertically, the columella transversely upon the hinder part of the back; and its head passes out under the margin of the mouth opposite to the columella. When the spire is turbinate, the whorls turn obliquely to the right side in nearly all the species, but in a small number to the left; and the latter are named *reversed*, [or *sinistrorsal*].

It is to be observed that the heart is always on the side opposite to that to which the spire is directed. It is, consequently, in general on the left, and only on the right in the reversed kinds. The contrary is the rule with the organs of generation.

The organs of respiration, which are always within the last whorl of the shell, receive the circumfluent element under its margin, sometimes because the cloak is detached from the body along the whole of this margin, and sometimes because it is perforated there with a hole. The margin of the cloak, in many Gasteropods, is prolonged into

a canal, through which they can reach and receive the circumfluent medium without extruding their head or foot from the shell. The shell has then, also, in its margin, near the end of the columella, opposed to that towards which the spire tends, an emargination, or furrow, wherein to lodge the canal of the cloak. Consequently, the canal is to the left in common, but to the right in the reversed species.

Further, the animal being very flexile, can vary the direction of the shell, and oftenest when there is an emargination or furrow, it directs the canal forwards, whence it happens that the spire points to behind, the columella to the left, and the opposite margin to the right. The contrary of this occurs in the reversed sorts: and this is the reason that we say that their shell turns to the left, [or is *sinistral*].

The mouth of the shell, and consequently also the last whorl, is greater or less, in relation to the other whorls, according as the head or the foot of the animal is more or less voluminous in relation to the mass of viscera which remains fixed within the shell; and the mouth is wider or narrower just as the same parts are more or less broad. There are shells whose mouth is narrow and long; and there it is that the foot is thin, and doubles on itself before it can be retracted.

The greater number of the aquatic Gasteropods with a spiral shell, have an *operculum*, or a corneous or calcareous plate, affixed upon the posterior part of the foot, to close the aperture when the snail has withdrawn within the shell.

There are Gasteropods with separate sexes, and others which are hermaphrodites; and of these some are capable of self-impregnation, while, in others, the copulation of two individuals is required.

Their organs of digestion do not vary less than those of respiration.

The class is so numerous that we have deemed it expedient to divide it into a certain number of orders, the characters of which we have drawn from the position and the form of the branchiæ.

The Pulmonea

Breathe the atmosphere, receiving the air within a cavity whose narrow orifice they can open and close at will: they are hermaphroditical, with reciprocal copulation: some have no shell, others carry one, which is often truly turbinate, but never furnished with an operculum.

The Nudibranchiata

Have no shell, and carry their variously-figured branchiæ naked upon some part of the back.

The Inferobranchiata

Are similar, in some respects, to the preceding, but their branchiæ are situated under the margins of the cloak.

The Tectibranchiata

Have their branchiæ upon the back, or upon the side, covered by a lamina, or fold of the cloak, which almost always contains a shell more or less developed; or sometimes the branchiæ are enveloped in a narrow fold of the foot.

These four orders are hermaphroditical, with reciprocal copulation.

The Heteropodes

Carry their branchiæ upon the back, where they form a transverse row of little tufts, and are, in some instances, protected, as well as a portion of the viscera, by a symmetrical shell. What best distinguishes them is the foot compressed into a thin vertical fin, on the margin of which a little sucker often appears,—the only trace left of the horizontal foot of the other orders of the class.

THE PECTINIBRANCHIATA

Have the sexes separated: their respiratory organs consist almost always of branchiæ composed of lamellæ united in a pectinated form, and which are concealed in a dorsal cavity opening with a wide gape above the head. Nearly all of them have turbinated shells, with the mouth sometimes entire, sometimes emarginate, sometimes produced into a syphonal canal, and generally capable of being more or less exactly closed by an operculum attached to the foot of the animal behind.

THE SCUTIBRANCHIATA

Have branchiæ similar to those of the Pectinibranchiata, but they are complete hermaphrodites, and require no union with a second to effect impregnation: their shells are very open, and in several like a shield; they never have any operculum.

THE CYCLOBRANCHIATA

Are hermaphrodites of the same kind as the Scutibranchiata, and have a shell consisting of one or several pieces, but in no case turbinate nor operculate: their branchiæ lie under the margin of their cloak, as in the Inferobranchiata.

THE FIRST ORDER OF GASTEROPODES.

THE PULMONEA.*

From other Mollusca, those of this order are distinguished in this,—that they breathe the atmosphere through a hole which opens under the margin of their cloak, and which they can dilate or contract at pleasure. They have, also, no branchiæ, but only a network of pulmonary vessels, which creep upon the walls, and more particularly upon the ceiling of their respiratory cavity. Some of them are terrestrious, and others live in the water, but these are necessitated to come, from time to time, to the surface, to receive within their pulmonary cavity the air fit for respiration. All of them are hermaphrodites.

The TERRESTRIAL PULMONEA have almost all four tentacula, for, in a few only, of small size, we cannot see the inferior pair, probably because of their littleness.

Those of them which have no apparent shell, form the genus

LIMAX—

Of Linnæus, which is divided as follows:—The *Limaces*, properly so called (*Limax*, Lam.), have an elongated body, and a closely-fitted fleshy disk, or shield, for a cloak, which occupies merely the anterior part of the back, and covers only the pulmonary sac. It contains, in several species, a small, oblong, flat shell, or at least, in lieu of it, a calcareous [molecular] deposition. The respiratory orifice is at the right side of the shield, and the anus opens near it. The four tentacula are protruded and withdrawn by a process of evolution and involution; and the head itself can be contracted partially under the disk of the cloak. The orifice of the generative organs is under the right superior tentaculum. In the mouth is an upper jaw only, of a crescent form, and toothed, which enables them to devour with voracity herbs and fruits, to which they are very destructive. Their stomach is elongated, simple, and membranous.

Fig. 157 —Limax rufus.

M. de Ferussac distinguishes the *Arions* by the respiratory orifice being towards the anterior part of the shield, in which there are only calcareous granules. *Limax rufus*, Linn., is an example which we meet with every step in moist seasons, and which is sometimes almost wholly black. It is the species of which a broth is used in diseases of the chest. The *Limax* proper, has the orifice near the hinder part of the shield, and it contains a more distinctly formed shell Such are the *Limax maximus* and *L. agrestris* of Linn.

* *Pulmobranchiata* of Blainville. [In consequence of some objections to the term *pulmonated* being applied to any invertebrated animals, urged by Lamarck, English authors often call this order the *Pneumonobranchous*.—ED.]

THE VAGINULUS, Feruss.*—

Has a close-fitted cloak without a shell, extended over the whole length of the body; four tentacula, of which the inferior are somewhat forked; the anus quite at the posterior extremity, between the end of the cloak and that of the foot; and the same orifice leads to the pulmonary cavity situated along the right flank. The orifice of the male organ of generation is under the right inferior tentaculum, and that of the female organ under the middle of the right side. These organs, as well as those of digestion, are very similar to those of the Snail. The genus belongs to both Indies, and is much like our Slugs.

THE TESTACELLÆ, Lam.—

Have the respiratory aperture, and the anus, near the posterior extremity; their cloak is very small, and also placed there, and contains a small ear-shaped shell, which does not equal one-tenth of the length of the body. In other respects, these animals resemble our Slugs.

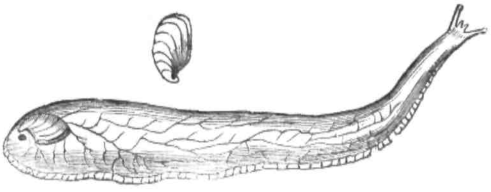

Fig. 158.—The Testacella

One species is found abundantly in our southern departments (*Testacella haliotoidea*, Diaparn.), living under ground, and feeding principally on earth-worms. M. de Ferussac has observed that its cloak assumes an extraordinary developement when the animal finds itself in too dry a situation, and thus produces for itself a sort of shade and shelter.

[There are some interesting illustrations of the habits of the Testacellæ in Loudon's *Magazine of Natural History*, vol. vii.]

THE PARMACELLA, Cuv.—

Has a membranous cloak, with loose margins, situated [upon a gibbosity] in the middle of the back, and containing, in its posterior part, an oblong flat shell, which exhibits the mere vestige of a spine. The respiratory aperture, and the anus, are under the right side of the middle of the cloak.

The first known species was from Mesopotamia (*Par. Olivieri*, Cuv.); but we have now one from Brazil, and some others from India.

In the terrestrial Pulmonea with a perfect and exterior shell, the margin of its aperture is in general thickened and reverted in the adult.

Linnæus referred to his genus

HELIX,—

Every species in which the aperture of the shell (somewhat encroached upon by the projection of the penultimate whorl) assumes a crescent-like figure.

When this lunated aperture is wider than it is deep, the shells belong to *Helix*, Brug. & Lam. In some, the shell is globular. Everybody knows the edible Snail (*Hel. pomatia*, Linn.), common in gardens and vineyards, and esteemed as a delicacy in some departments; and the common Snail (*Hel. nemoralis*, Linn.), remarkable for the vividness and variety of its colours, and very hurtful to garden stuffs in wet seasons. There is no one who has not heard of the curious experiments, showing to what extent they can reproduce amputated parts.

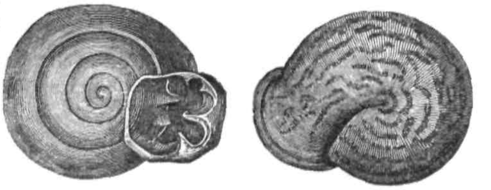

Fig 159.—Anastoma globosa

Other species have a depressed shell, or one with a flattened spire; and we ought not to pass over without notice such as have interiorly projecting ribs, nor those in which the last whorl is abruptly turned up in the adult [so that the aperture appears in the same plane as the spire], and then assumes an irregular plicated form,—hence denominated *Anastoma*† by Lamarck.

The *Vitrina*, Drap. (*Helico-Limax*, Feruss.), are Helices with an extremely thin subspiral shell, without an umbilicus, and with an ample aperture, whose margin is sharp and even. The body of the Snail is too large to be drawn within the shell. The cloak has a double edge; and the superior fold, which is divided into several lobes, may be made to overlap the shell so as to clean and polish it. The European species live in moist situations, and are very small; but there are some of large size in warm climates.

* Synonymous with the *Onchidium* of Buchanan; and the *Veronicella* of Blainville is not different.—ED.

† "The peculiarity which distinguishes this genus from all the other Heliciform Univalves is so extraordinary, that it appears to us to be deserving of particular notice, inasmuch as it evidences a considerable alteration in the habit and economy of the animal which produces it, at the time of its arrival at its last period of growth, when it forms the reflected outer lip, and the teeth in the aperture. Until then, the animal must crawl about like other Snails, with the spire of its shell uppermost; but as soon as it arrives at maturity, and is about to form its complete aperture, it takes a reverse position, and afterwards constantly carries its spire downwards."—SOWERBY. Two species are known.—ED.

We ought to arrange near them some Helices which, without having a double-edged cloak, are equally incapable of retreating within their shell. *Helix rufa* and *brevipes*, **Ferus.**, are examples.

When the depth of the aperture is greater than its width, as is always the case in shells with an oblong or elongated spire, they are the terrestrial *Bulimi* of Brug., which it appears necessary to subdivide as follows:—The *Bulimus*, Lam., have an oval rim, thickened in the adult, but without denticulations. In tropical countries, there are some large and beautiful species; some remarkable for the size of their eggs [equal to that of a Pigeon], and with an equally solid shell; and others for their reversed shells. In our own country there are several of small or moderate size, and one of them (*Helix decollata*, Gm.) has the singular habit of breaking off in succession the whorls from its spire. This example has been quoted as a proof that the muscles of the animal can be voluntarily detached from the shell; for a time does come when this Bulimus preserves no more than a single whorl of all those it possessed at the beginning of the decollation.

The *Pupa*, Lam., have an obtusely-pointed shell, whose last whorl is narrower than the penultimate, whence it has an elliptical, or sometimes a cylindrical form. The mouth is surrounded by a thickened rim, and encroached upon, on the side of the spire, by the penultimate whorl. The species are very small, living in moist stations, amongst mosses, &c. There is sometimes no toothlet in the aperture, but oftener there is one or more either on the projecting part of the penultimate whorl, or within the outer margin. [The genera *Vertigo*, Müll., and *Alæa*, Jeffreys, appear to have been separated from Pupa on too slight grounds; for the inferior tentacula are not absent, as is alleged, but only reduced to a minimum. The *Partula*, Fer., deserves probably to be kept distinct; for the species are ovo-viviparous, while all the others are oviparous.]

The *Chondrus*, Cuv., has, as in these latter Pupæ, the mouth of the shell encroached upon by the penultimate whorl, and guarded with plates or toothlets; but the figure of the shell is more ovate, and more like that of the common Bulimi. Some have the teeth on the rim of the aperture, and others have plaits situated deeper within it. [This genus appears to be synonymous with the *Azeca* of Leach.]

Here terminates the section of terrestrial Helices whose shell has a thickened oral rim [or *peritreme*] in the adult.

The *Succinea*, Drap., has an ovate shell, with an aperture longer than its width, as in Bulimus, but larger in proportion; the outer lip sharp, and the side of the columella almost concave. The Snail is too large to be contained in it, and we may almost regard it as a Testacella with a big shell. The inferior tentacula are very small. It lives upon the herbs and the shrubs of the brinks of rivulets, whence it has been considered as an amphibious genus.

We ought to separate from the genus *Turbo* of Linnæus, and approximate near the terrestrial Helices, the

CLAUSILIA, Drap.,—

Known by the slender, long, and pointed shell, with the last whorl narrower than the penultimate in the adult, compressed, and a little detached. Its mouth is entire and margined, and often toothed or furnished with plates. There is mostly found, within the last whorl, a little lamina [commonly termed the *clausium*], slightly curved, a little like the letter S, the use of which to the animal is unknown to us.* The species are small, and live in moss, at the foot of trees, &c. A great number of them are reversed.

THE ACHATINA, Lam.—

Ought likewise to be separated from the *Bullæ* of Linnæus, and brought hither. The oval or oblong shell has the aperture of Bulimus, but is not margined; and has the extremity of the columella truncated, which is the first index of the emarginations we find in so many of the shells of the marine Gasteropodes. These Achatinæ are large Snails which feed on trees and shrubs in hot climates.† Of such as have, within the last whorl, a callus or particular thickening Montfort makes his genus *Liguus*. The body-whorl is proportionably narrow; and when the end of the columella is curved towards the inside of the aperture, and the body-whorl is broader, the species constitute Montfort's *Polyphemes*.

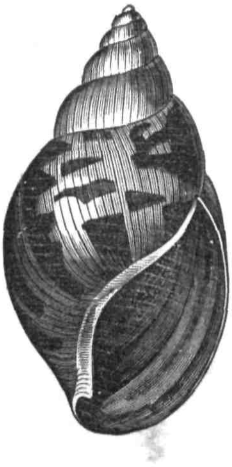

Fig. 160.—A. zebra

Fig. 161.—A. virginea.

* The use is to close the aperture of the shell when the Snail has retired. See a good description of its mechanism by Mr. J. E. Gray, in *Zool. Journ.* vol. i. p. 212.—ED.

† "The greater number of Achatinæ," says Sowerby, "are African shells: some are West Indian, and a very few European. Among the latter, we can only lay claim to one as decidedly a native of this country, the *A. acicula* of Lamarck."—ED.

THE AQUATIC PULMONEA have only two tentacula. They come ever and anon to the surface to breathe, so that they can only inhabit waters of inconsiderable depth: thus they live in fresh waters or in brackish pools, or at least near the sides and mouths of rivers.

There are some amongst them without a shell: such is the

ONCHIDIUM, Cuv.*

A large fleshy cloak, of the shape of a buckler, overlaps the foot on every side, and even covers the head when this is contracted. It has two long retractile tentacula, and over the mouth a veil, sinuated, or formed of two triangular compressed lobes. The anus and air-passage are under the hinder margin of the cloak, where, a little deeper, we find also the pulmonary sac. Near them, to the right, is the opening of the female organs, while, on the contrary, that of the male organ is under the right tentaculum; and these two orifices are united by a groove which runs under and along the right edge of the cloak. Destitute of jaws, they have a muscular gizzard, succeeded by two membranous stomachs. Several species inhabit the coasts of the sea, but always in such a situation that they are uncovered at ebb tide, when they obtain the air necessary to respiration.

The Aquatic Pulmonea, with perfect shells, have been placed by Linnæus in his genera *Helix*, *Bulla* and *Voluta*, whence they ought to be withdrawn. In Helix were the two following genera, whose aperture, as in Helix, had its inner [or pillar] margin protuberant and arcuate:—

THE PLANORBIS, Brug.,—

Had already been distinguished from Helix by Bruguières, and even previously by Guettard, because the whorls of their shell, rolled up nearly on a level, enlarge insensibly, and the mouth is wider than deep.† It contains a Snail with long, slender, filiform tentacula, at the inner base of which the eyes are situated. It can exude, from the margin of its cloak, a copious red liquor, which is not to be mistaken for its blood. The stomach is muscular, and the food vegetable, as in the Limnææ, which are the faithful companions of the Planorbes in all our stagnant waters.

THE LIMNÆUS, Lam.,

Were separated from the Bulimus of Bruguières, because, notwithstanding the similarity of the shells, the margin of the *Limnees* is sharp-edged and not reflected, and their columella has an oblique fold.

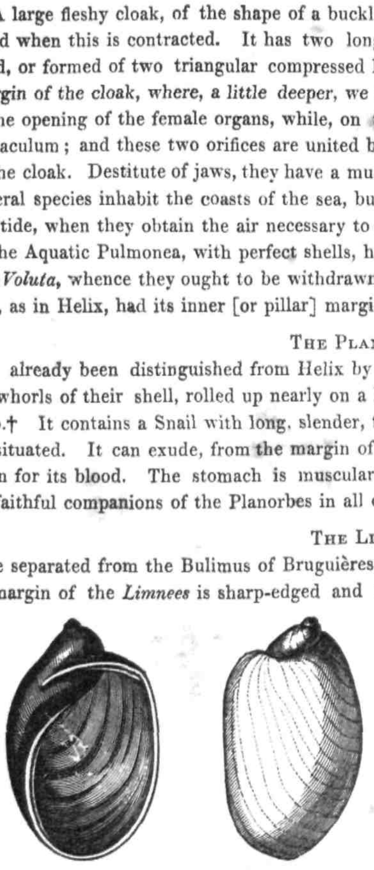

Fig. 162.—Limnæa stagnalis.

The shell is thin: the animal has two compressed, broad, triangular tentacula, with the eyes sessile at their inner base. They feed upon plants and seeds; and their stomach is a very muscular gizzard, furnished with a crop. Hermaphrodites, after the fashion of their order, they have the female organ rather widely apart from the other,—a structure which compels them to copulate in such a manner that the individual acting as a male to his mate is the female to a third, and from this peculiarity we occasionally find them joined together in long strings. They abound in stagnant waters; and they are found plentifully, as well as the Planorbes, in marly or calcareous beds, which we thus discover to have been deposited from fresh water.

THE PHYSÆ,—

Which were arranged arbitrarily among the Bullæ, have the shell of Limnæus, but still thinner, and there is no fold on the columella. The animal, when it swims or creeps, covers its shell with the two pectinated lobes of the cloak: it has two long setaceous tentacula, which are bulged at the base where the eyes are placed.

The species are small, and live in clear ponds. One of them (*Bulla fontinalis*, Lam.), has its whorls sinistral, [and this, indeed, is the only certain character which distinguishes the genus from Limnæus.]‡

* M. de Blainville has changed the name Onchidium into *Peronia*, and transfers the first to the Vaginulus. He places Peronia amongst his *Cyclobranchia*; but I cannot perceive any real difference between their respiratory organ and that of the other Pulmonea. [As this genus is not the Onchidium of Buchanan, as Cuvier supposed, M. de Ferussac proposes to name it *Onchis*.]

† Sowerby maintains that the shell in Planorbis is always reversed, or *sinistral*.—ED.

‡ When the shell is oval-globose, and the cloak sufficiently ample to cover it, in an expanded state, the genus is the *Amphipeplea* of Nilson; [and when the shell is turreted, and the cloak entire, the genus is named *Aplexa* by Fleming.—ED.]

From the observations of Van Hasselt it seems that we must here arrange

THE SCARABES, Montf.

The shell is oval, and the aperture contracted by large teeth projecting from both the columellar side as well as the outer lip: this lip is swollen, and as the animal re-makes it after every half-whorl, the shell is most protuberant on two opposite lines, and has a flattened aspect. The animals live on aquatic plants in the Indian Archipelago.

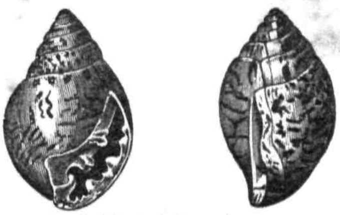
Fig. 163.—Auricula scarabæus

The two genera which follow were misarranged among the Volutes.

AURICULA, Lam.,—

Differing from all preceding aquatic Pulmonea by having their columella striated with large oblique channels. Their shell is oval or oblong; the aperture of the shape of the Bulimus or Limnæus; the lip furnished with a varix. Several species are of considerable bulk; but it is not ascertained if they live in marshes, like the Limnæus, or merely upon their margins, after the manner of the Succinea.

[One species, according to Lesson, lives in fresh water; the others appear to be terrestrial, living on rocks by the sea-side.] We find only one in France, from the coast of the Mediterranean (*Auricula myosotis*, Drap.) The male has two tentacula, and the eyes are at their bases. [*Carychium*, Muller, answers so nearly to the description of Auricula, that the genera ought probably to be conjoined. The typical species (*C. minimum*) lives under leaves in shaded woods.]

THE MELAMPES, Montf. (*Conovulus*, Lam.),

Like the Auricula, have prominent plaits on the columella, but their aperture has no varix, and its inner lip is finely striated: the shell has somewhat the shape of a cone, of which the spire makes the base. They inhabit the rivers of the Antilles.

THE SECOND ORDER OF THE GASTEROPODES.

THE NUDIBRANCHIATA.*

They have neither a shell nor pulmonary cavity, but their branchiæ are exposed naked upon some part of the back: they are all hermaphroditical and marine: they often swim in a reversed position, the foot applied against the surface, and made concave like a boat; and they assist their progress by using the edges of the cloak and the tentacula as oars.

THE DORIS, Cuv.,—

Have the anus in the posterior part of the back, and the branchiæ are arranged in a circle round the anus; and as each resembles a little arbuscule, they constitute altogether a sort of flower. The mouth is a small proboscis, situated under the anterior edge of the cloak, and is furnished with two small conical tentacula. There are other two tentacula, of a conoid figure, [and lamellated structure,] which issue from the superior and anterior part of the cloak. The organs of generation have their orifices near to each other, under its right margin. The stomach is membranous. A gland, intimately interlaced with the liver, sheds a peculiar secretion, that escapes outwards by a hole near the anus. The species are numerous, and some of them of considerable size. We find them on the shores of every sea.† Their spawn is shed in the form of a gelatinous ribbon, on rocks and sea-weeds, &c.

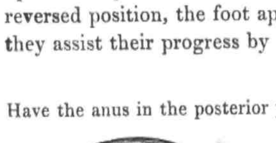
Fig. 164.—Doris cornuta

The *Onchidores*, Blainv., only differ from the Doris in the wider separation of their sexual organs, whose orifices communicate by a furrow drawn along the right side, as in the Onchidia. The *Plocamoceres*, Leuckard, have all the characters of Onchidores, and moreover the anterior edge of their cloak is adorned with numerous branched tentacula. The branchiæ of *Polycera*, Cuv., are like those of Doris, but simpler, and furnished with two mem-

* My first four orders are joined together by M. de Blainville into what he calls a sub-class, and names *Paracephalophora monoica*. Of my Nudibranchiata he makes two orders: in the first (*Cyclobranchiata*) he places the Dorides; in the second (*Polybranchiata*) the Tritoniæ and its allies, which he divides into two families, according as they have two or four tentacula.

† The Scottish species are described by Dr. Johnston in the 1st vol. of the *Annals of Natural History*; and Montagu has described many British species in the *Linnæan Transactions*.—ED.

branous laminæ to cover them in time of danger: and besides the two conoid tentacula in front, similar to those of Doris, they have four, or sometimes six others, which are simply pointed.

THE TRITONIES (*Tritonia*, Cuv.),—

Have a body, superior tentacula, and generative organs, as in the Doris; but the anus and the vent of the peculiar secretion are on the right side, behind the vulva: the arbuscular branchiæ are arranged along each side of the back, and the mouth, guarded by broad membranous lips, is armed within with two lateral horny and cutting jaws, in shape somewhat like to the scissors for shearing sheep.

Fig. 165.—Tritonia.

We have a large species (*Tritonia Hombergii*, Cuv.) on our coasts; and there are many others, some of them very small, which exhibit great variety in the size and figure of their branchiæ. [*Melibea*, Rang, differs in having filiform simple tentacula issuing from a wide sheath, and two series of ovate muricated or tuberculated branchiæ on the back, which readily fall off when the animal is handled. *M. rosea*, which lives on floating sea-weeds near the Cape of Good Hope, is the type; but there are some European Mollusca, of small size, which are also referable to it.]

THE THETHYS, Linn.,—

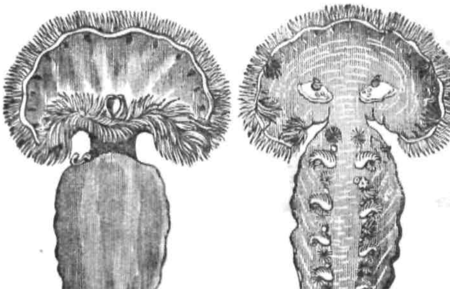
Fig. 166.—Thethys leporina, upper and under sides.

Have along the back two rows of tufted branchiæ; and upon the head a very large membranous fringed veil, which curves, in its contraction, under the mouth. The mouth is a membranous proboscis without jaws: there is at the base of the veil two compressed tentacula, from the margin of which issues a small conical point. The orifices of generation, of the intestine, and of the peculiar secretion, are as in Tritonia. The stomach is membranous, and the intestine very short.

There is, in the Mediterranean, a beautiful species of a greyish colour, spotted with white (*Thetis fimbria*, Linn.).

THE SCYLLÆA, Linn.

In this genus the body is compressed; the foot narrow and furrowed, to enable it to embrace the stems of sea-weed; no veil; the mouth forming a small proboscis; the exterior orifices as in Thethys; the tentacula compressed, terminating in a cavity from which a little point, with an unequal surface, can be protruded; and upon the back are two pairs of membranous crests, carrying, on their inner aspect, some pencils of branched filaments. The middle of the stomach is covered with a fleshy ring, armed with horny laminæ as sharp as a knife. The common species is found on *Fucus natans*, or gulf-weed, wherever this appears.

Fig. 167.—Scyllæa pelagica

THE GLAUCUS, Forster,

Have the elongate body and the vents as in the preceding; four minute conical tentacula; and on each side [two or] three branchiæ, each formed of long fringes arranged like a fan, and by whose means they swim. They are little charming Molluscs of the Mediterranean and Indian Ocean, agreeably painted with azure-blue and silver, and swim with great quickness on their backs. Their anatomy closely resembles that of Tritonia. The species have not, as yet, been satisfactorily distinguished.

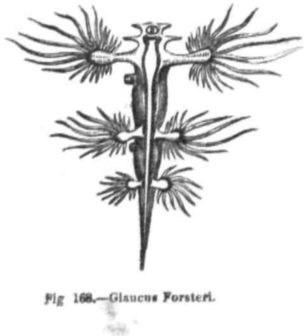
Fig 168.—Glaucus Forsteri.

The *Laniogerus*, Blainv., has, on each side, two series of little plates, finely divided in a pectinate manner, which are the branchiæ. The body is shorter and thicker than in Glaucus, but they have its four little tentacula.

THE EOLIDIA, Cuv.,

Resemble little slugs, with four tentacula above, and two on

the sides of the mouth. Their branchiæ are tentaculiform processes or papillæ disposed along the sides, overlying like scales, [or held erect]. They inhabit all seas.

The *Cavolina*, Bruguière, have the habit of Eolidia, but their branchiæ are disposed in rows across the back.

The *Flabellines*, Cuv., still exhibit the tentacula of the preceding genera, with branchiæ composed of radiating filaments supported on five or six pedicles on each side. They approximate the Glaucus; and in general it is to be remarked, that all the Nudibranchiata with branchiæ placed upon the sides of the back are nearly affined.

THE TERGIPES, CUV.,

Are in shape like the Eolidia, but have only two tentacula, and along each side of the back there is a row of cylindrical branchiæ, each terminated by a little sucker, which enables them to be used as feet: hence the creature can walk in a reversed posture. [This singular structure of the branchiæ, and their pedestrious use, requires to be confirmed.] The known species are very small.

The *Busiris*, Risso, is known by its oblong body, convex back, two filiform tentacula, and behind them, upon the neck, two plumose branchiæ.

The *Plocobranchus*, Van Hasselt, has two tentacula, and two labial lobes, and the whole back, widened at the sides, covered with numerous radiating striæ, which are the branchiæ. In their natural conditions, the widened margins of the cloak are raised, and overlap each other so as to form a covering to the branchiæ, which are thus placed in a sort of cylindrical sheath. The only species yet known is from the shores of Java.

THE THIRD ORDER OF THE GASTEROPODES.

THE INFEROBRANCHIATA.

These have nearly the habit and organization of *Doris* and *Tritonia*, but their branchiæ, instead of being situated upon the back, are on the sides of the body, under the projecting margin of the cloak, where they form two long series of leaflets. [The species are strictly littoral, being gasteropodous and incapable of swimming.]

THE PHYLLIDIA, CUV.

Their naked, and generally coriaceous cloak, is not protected by any shell. Their mouth is a small proboscis, and has a tentaculum at each side; two other tentacula protrude above from two little cavities of the cloak. The anus is in the hinder part of the cloak, and the orifices of generation under the right side in front. The heart is about the centre of the back; the stomach is simple, membranous, and the intestine short. There are several species in the Indian ocean.

THE DIPHYLLIDES, CUV.—

Have branchiæ nearly similar to those of Phyllidia, but the cloak is more pointed behind; the head, of a semicircular figure, has a pointed tentaculum on each side, and a slight tubercle: the anus is on the right side.

[The *Ancylus*, Geoffroy,—a fresh-water Gasteropode, with a shell similar to that of a Patella, is placed by Rang in this order. He asserts that the animal is branchiferous, while the Rev. Mr. Berkeley has asserted that it is pulmonated. They live in stagnant waters and in rivulets, adhering to stones and aquatic plants.]

THE FOURTH ORDER OF THE GASTEROPODES.

THE TECTIBRANCHIATA.*

They have their branchiæ attached along the right side, or upon the back, in the form of more or less divided, but not symmetrical, leaflets; these are more or less covered by the mantle, in which a small shell is generally contained. They approximate the Pectinibranchiata

* The *Monopleurobranchiata* of Blainville.

in the form of the respiratory organs, and, like them, live in the sea; but they are hermaphrodites, like the Nudibranchiata and Pulmonea.

THE PLEUROBRANCHUS, Cuv.*

The cloak and the foot both jut beyond the body, which thus appears as if it were between two bucklers. The former contains, in some species, a little oval calcareous plate; in others, a horny one, and in either case it is situated above the head. The branchiæ are placed along the right side, in a groove between the cloak and foot, and represent a series of pyramids divided into triangular leaflets. The mouth, in the form of a small proboscis, is overhung with an emarginate lip, and with two tubular cleft tentacula; the orifices of generation are before, and the anus behind the branchiæ. There are four stomachs, of which the second is fleshy, sometimes armed with osseous pieces, and the third is garnished with prominent longitudinal laminæ. The intestine is short.

There are different species in the Mediterranean and Indian Ocean, some of which are large and beautiful. [We have two British species.]

THE PLEUROBRANCHÆA, Meckel (*Pleurobranchidium*, Blainv.),—

Has the branchiæ and the orifices of generation situated as in Pleurobranchus; but the anus is above the branchiæ; the margins of the cloak and of the foot project but a little, and upon the front of the cloak are four short distant tentacula, forming a square which forces a comparison with the anterior disk of the Aceres. I find but one stomach, with thin parietes, which is a mere dilatation of the intestine. A greatly divided glandular organ opens outwardly behind the genital orifices. There is no trace of a shell.

The only known species is from the Mediterranean.

THE APLYSIA, Lin.

The margins of the foot are turned up into flexile crests, and, surrounding the back on every side, they can be reflected over it. The head, supported on a neck of greater or less length, has the two superior tentacula hollowed like the ears of a quadruped, and two others of a flattened shape at the end of the inferior lip; the eyes at the base of the former. Upon the back we find the branchiæ in the form of complicated leaflets, attached to a broad membranous pedicle, and concealed by a little cloak, equally membranous, which contains a horny flat shell. The anus is behind the branchiæ, and is often concealed under the lateral crests: the vulva is to the right in front, and the penis issues from under the right tentaculum. A groove, which extends from the vulva to the very extremity of the penis, conducts the semen thither in copulation. A membranous crop, of enormous size, leads into a muscular gizzard, armed inside with many cartilaginous and pyramidal bodies; and this is followed by a third stomach beset with sharp hooks, and a fourth in the form of a cœcum. The intestine is voluminous. These animals feed on sea-weed. A peculiar gland pours out, through an orifice near the vulva, a limpid humour, which is said to be very acrid in some species; and from the edges of the cloak there oozes in abundance a deep purple liquid, with which the animal discolours the water of the sea when it perceives danger to be at hand. Their ova are laid in long glairy entangled filaments, as slender as threads.

There are found in our seas *Apl. fasciata*, Poiret, *punctata*, Cuv., and *depilans*, Linn.; and the shores of foreign countries possess several others.

THE DOLABELLA, Lam.—

Differs only from Aplysia in the position of the branchiæ at the posterior extremity of the body, which resembles a truncated cone. The lateral crest fits close to the branchial apparatus, leaving merely a narrow groove. The shell is calcareous.

The species are found in the Mediterranean and in the Indian Ocean.

THE NOTARCHUS, Cuv.—

Has the lateral crests united and covering the back, leaving merely a longitudinal fissure to conduct water to the branchiæ. These have no cloak to cover them, but in other respects they resemble the branchiæ of the Aplysia; and the organization of the two genera is otherwise similar. In

* The same as the *Lamellaria* of Montagu, [a name which the Botanists have usurped,] and the *Berthella* of Blainville. [This genus, Pleurobranchæa, Umbrella, Spiricella, and Siphonia, are placed in the preceding order by Rang.]

THE BURSATELLES, Blainv.,—

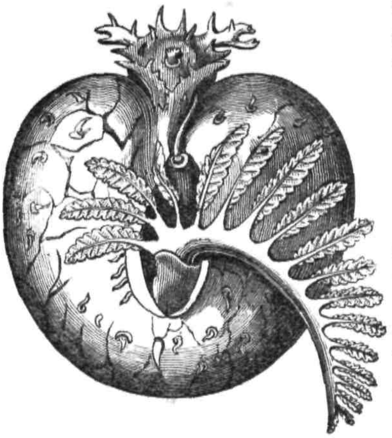

Fig. 169.—Bursatella Leachii.

The lateral crests are united in front, so as only to leave an oval opening for the water to pass to the branchiæ which are also destitute of a covering cloak. It is, however, probable that this genus should be allowed to lapse into the Notarchus.*

THE ACERES, (*Akera*, Muller)—

Have the branchiæ covered like the preceding genera, but their tentacula are so much shortened, widened, and separated, that there seems to be none at all, or rather they form together a large, fleshy, and nearly square buckler, under which the eyes are placed. Moreover, their hermaphroditism, the position of their sexual organs, the complexity and structure of the stomach, the purple liquid which several of them shed, all approximate them to the Aplysiæ. The shell, in such as have one, is more or less convolute, with a slight obliquity, without a visible spire, and the mouth has neither sinus nor canal; but as the columella is convex and protuberant, the mouth has a crescent-like shape, and the part opposite to the spire is always widest and rounded. When the shell is buried in the cloak, M. de Lamarck names the genus Bullæa. The shell has few whorls, and is too small to contain the animal.

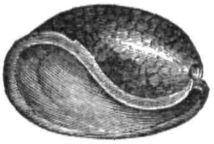

Fig. 170.—Bullæa aperta.

The *Bullæa aperta*, Lam., is an example which is found in almost every sea, where it lives on oozy bottoms. When the shell is [external], covered with a thin epidermis and sufficiently roomy, M. de Lamarck allows them to retain the old name *Bulla*. The *Bulla lignaria*, *ampulla*, and *hydatis* are examples, [distinguished not only by the characters of the shells, but by peculiarities in the armature of the stomach, which consists of two or three comparatively large osseous pieces or jaws of different shapes in each. Of those of *B. lignaria*, Gioeni constituted a genus to which he assigned his own name; it is the *Tricla* of Retzius, the *Char* of Bruguière, and disfigured our systems until the cheat was detected by Draparnaud.] I restrict the term *Acera* to such species as have no shell whatever, or merely a vestige of it behind, although the cloak has the external form of one. The genus is the *Doridium* of Meckel and *Lobaria*, Blainv. There is a small species in the Mediterranean (*Bulla carnosa*, Cuv.), whose stomach is as destitute of any armature as its cloak is of a shell, but the œsophagus is fleshy and very thick.

Fig. 171.—Bulla lignaria.

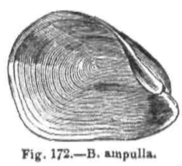

Fig. 172.—B. ampulla.

THE GASTEROPTERON, Meckel,—

Appears to be only an Aceres with the sides of the foot expanded into broad fins, by whose aid it is enabled to swim, which it does in a reversed position. It also has no shell, and no stony apparatus in the stomach. A very slight fold of the skin is the sole vestige of a branchial cover to be observed.

The one species known (*G. Meckelii*) is a Mediterranean Mollusk, about an inch long by two in breadth, when its wings are spread out.

Until a more ample anatomy has been made of it, we believe that it is in this order, and near to the Pleurobranchus, that the singular genus

UMBRELLA, Lam. (*Gastroplax*, Blainv.)—

Should be placed. The animal is a great circular Mollusk, whose foot exceeds by much the cloak, and has its upper surface roughened with tubercles. The viscera are in a superior and central rounded part. The cloak is only visible by its slightly projecting sharp edge along the entire front, and on the right side. Under this slight edging of the cloak are the branchiæ, in lamellated pyramids, like those of Pleurobranchus; and behind them is a tubular anus. Under this same margin, in front, are two

* *Aplysia viridis*, Montag., raised to a genus by Oken under the name of *Actæon*, and which is at least nearly allied to the *Elysia timida* of Risso, has been considered as a near ally of Aplysia, but from want of a knowledge of the branchiæ, I cannot classify it. [The branchiæ cover the back and the superior surface of the lobes under the form of a vascular network, so that the true position of the Elysia is next to Placobranchus.]

tentacula, longitudinally cleft as in Pleurobranchus, and at their inner bases are the eyes: between them is a kind of proboscis, perhaps an organ of generation. There is a large concave space in the anterior margin of the foot, the edges of which can be drawn together like the mouth of a purse; and at its bottom is a tubercle pierced with an orifice, which is perhaps the mouth, and is surmounted by a fringed membrane. The inferior surface of the foot is smooth, and serves the animal to crawl on, as in other Gasteropodes. *It carries with it a hard, flat, irregularly-rounded shell, thickest in the centre,* with sharp margins, and lightly marked with concentric striæ. It was supposed at first that the shell was attached to the foot, but more recent observations have proved that it is upon the cloak, and in its usual place.

[Two species have been discovered: one in the Indian Ocean, the other in the Mediterranean.]

THE FIFTH ORDER OF THE GASTEROPODES.

THE HETEROPODA, LAM.*

The Heteropoda are distinguished from all other Mollusca by their foot, which, instead of forming a horizontal disk, is compressed into a vertical muscular lamina, which they use as a fin; and on the edge of which, in several species, is a sucker in the form of a hollow cone, that represents the disk of the other orders. Their branchiæ, formed of plumose lobes, are situated on the hinder part of the back, and point forwards; and immediately behind them are the heart and liver, of inconsiderable size, with a portion of the viscera and the interior organs of generation. The body, of a transparent gelatinous substance, sheathed with a muscular layer, is elongate, and generally terminated with a compressed tail; the mouth has a muscular mass and a tongue garnished with little hooks; the gullet is very long; the stomach thin; two prominent tubes, on the right side of the bundle of the viscera, serve as passages to the excrements, and to the eggs or semen. They swim, in ordinary, in a reversed position; and they can inflate the body with water in a manner which is not yet well understood.

Forskal comprised them all under his genus *Pterotrachea*, which it is necessary to subdivide.

THE CARINARIA, Lam.,—

Has the nucleus (formed by the heart, the liver, and organs of generation,) covered with a thin, symmetrical, conoid shell, with the point curved backwards, and often raised into a crest; under its anterior margin, the plumes of the branchiæ float; on the head are two tentacula, and the eyes are behind their roots.†

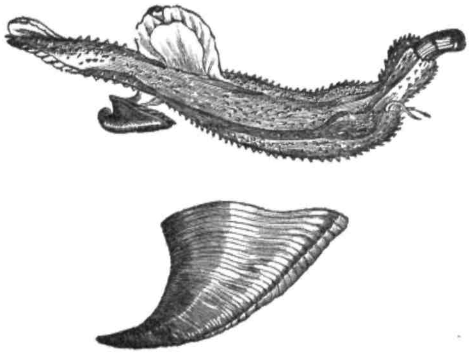

Fig. 173.—Carinaria: the shell of its natural size, and a reduced figure of *the animal, with the position of the shell on it.*

One species (*Car. cymbium*, Lam.) inhabits the Mediterranean; another the Indian Ocean (*Car. fragilis*, B. St. Vincent). The *Argonauta vitrea* of authors may be a Carinaria, but its animal is unknown.

THE ATLANTA, Lesueur, —

From the observations of M. Rang, should be animals of this order, whose shell, in place of being expanded, has a narrow cavity, and a spire rolled up on the same plane: its contour is raised into a thin crest. They are very small shells of the Indian Sea; and in one of them, Lamanon believed that he had found the original of the Ammonites.

* M. de Blainville makes a family of this order, which he names *Nectopoda*, and unites them in his *Nucleobranchiata* with another family named the *Pteropoda*, comprising, however, only Limacina of my Pteropodes. He adds to it, upon I know not what conjecture, the Argonauta. [*Sowerby has also contended for Argonauta being arranged near to Carinaria.*]

† See a description of the animal by M. Verony in the *Zool. Journ.* vol. v. p. 325.—ED.

THE FIROLA, Peron,—

Has the body, the tail, the foot, the branchiæ, and the nucleus of the viscera, nearly the same as the Carinaria, but no shell has been observed. Their snout is prolonged into a recurved proboscis, and their eyes are not fronted with tentacula. There is often seen hanging at the end of their tail, a long jointed thread, which Forskal considered to be a Tape-worm, and the nature of which is not yet certainly determined.

One species (*Pterotrachea coronata*, Forsk.) is very common in the Mediterranean; and M. Lesueur has described several others from the same sea as different, but they require new and comparative examinations. Such as have the body abruptly truncate behind the visceral nucleus, instead of being terminated with a tail, M. Lesueur distinguishes as *Firoloides*.

To these genera, now well known, I suppose we shall, on a better acquaintance with them, have to add the *Timoriennes*, Quoy & Gaym., which appear to be Firolæ deprived of their foot and nucleus of viscera; and the *Monophores* of the same naturalists, which have nearly the form of Carinaria, but are also footless and shelless, nor have any visceral nucleus.

It is not so certain that we should place here the *Phylliroes* of Peron. The body, transparent and much compressed, has in front a snout surmounted with two long tentacula without eyes; behind, a truncate tail; and we can see through the integuments its heart, its nervous system, its stomach, and the genital organs of both sexes. The anus, and the orifices of the genital organs, are also on the right side, and a penis of considerable length is sometimes even protruded; but I cannot perceive any other respiratory organ than its thin and vascular skin.

THE SIXTH ORDER OF THE GASTEROPODS.

THE PECTINIBRANCHIATA.*

This order is, beyond comparison, the most numerous of the class, since it comprehends almost all the univalve spiral shells, and several which are simply conical. The branchiæ, composed of numerous leaflets or fringes, ranged parallelly like the teeth of a comb, are affixed in one, two, or three lines (according to the genera) to the floor of the pulmonary cavity, which occupies the last whorl of the shell, and which communicates outwards by a wide gape between the margin of the cloak and the body. Two genera only—*Cyclostoma* and *Helicina*—have, instead of branchiæ, a vascular network clothing the ceiling of a cavity in all respects the same as that of the order; and they are the only ones which respire the atmosphere, water being the medium of respiration to all the rest.

All the Pectinibranchiata have two tentacula and two eyes, raised sometimes on pedicles; a mouth in the form of a proboscis, more or less lengthened; and separate sexes. The penis of the male, attached to the right side of the neck, cannot, in general, be drawn within the body, but is reflected into the branchial cavity; it is sometimes very large. The Paludina alone has the organ concealed, and it comes out through a hole pierced in the right tentaculum. The rectum and the oviduct of the female also creep along the right side of the branchial cavity; and there is between them and the branchiæ a peculiar organ, composed of cells filled with a very viscous fluid, the use of which is to form a common envelope for the inclosure of the eggs, and which the animal deposits with them. The form of that envelope is often very complicated and very remarkable.

The tongue is armed with little hooks [or curved spinules], and wears down the hardest bodies by slow and oft-repeated frictions.

The grand difference between these animals lies in the presence or absence of the canal formed by the prolongation of the margin of the branchial cavity on the left side, and which

* In M de Blainville's system, it forms the subclass *Paracephalophora dioica*.

passes along a similar canal or sinus in the shell, to enable the animal to breathe without leaving its shelter. There is also this distinction between the genera—that some want the operculum; and the species vary in the filaments, fringes, and other ornaments that deck the head, the foot, or cloak.

We arrange these Mollusca under several families from the form of their shells, which appears to be in sufficiently constant harmony with that of their respective animals.

THE FIRST FAMILY OF THE PECTINIBRANCHIATA,—

THE TROCHOIDES,—

Is recognized by their shell having an entire aperture, without sinus or canal for a siphon, which the animals have not*; and in being furnished with an operculum, or some organ as its substitute.

THE TROCHUSIDÆ (*Trochus*, Linn.).†

The mouth of the shell, angular at its exterior margin, approaches more or less to a quadrangular figure, and is in an oblique plane in relation to the axis of the shell, because that part of the margin next the spire advances more than the rest. The greater number of the animals have three filaments on each side of the cloak, or at least some appendages to the sides of the foot.

Among those which have no umbilicus, there are some in which the columella, in form of a concave arch, is continuous, without any projections, with the exterior margin. It is the angle and advance of this margin that distinguishes them from Turbo. These are the *Tectaria*, Montf. Several are flattened, with a sharp [spiny] margin, whence they have been compared to the rowel of a spur; these are the *Calcar*, Montf. Some again are a little depressed, orbicular, glossy, with a semicircular aperture and a convex callous columella; Lamarck calls such *Rotella*. Others have the columella marked near the base with a little prominence or vestige of a tooth, similar to that of Monodonta, from which these Trochoides differ only in the general shape of the aperture, which is, in the present instances, a little deeper than wide:—they are the *Cantharides*, Montf. The aperture in others is, on the contrary, much wider than deep, and their concave base gives them a resemblance to the Calyptreæ; these Montfort names *Entonnoirs*. Others, in which the aperture has the same great proportional width, have the columella in the form of a spiral canal. And those which have the shell turreted (*Telescopium*, Montf.) resemble the Cerithia.

Among the umbilicated Trochusidæ, some have no longer any projection on the columella; the greater number are flattened, and have the exterior angle sharp. Of this kind is *Trochus agglutinans*, Linn., remarkable for its habit of gluing and incorporating with its shell, in proportion as it grows, different foreign bodies, such as gravel, fragments of other shells, &c. It often covers its umbilicus with a testaceous plate. There are some also with rounded margins, of which we have a common example on our coasts, (*Tr. cinerarius*, Linn.). Other umbilicated Trochi have a prominence near the base of the columella: and lastly, in others it is crenulated throughout its length.

The *Solarium*, Lam., is distinguished from the other Trochi by its obtusely conical spire, whose broad base is perforated with a wide and deep umbilicus, in which the eye can trace the margins of all the whorls winding up [like an elegant miniature staircase], and prettily crenulated. The *Euomphalus*, Sowerby, are fossil shells similar to Solarium, but without crenulations on the inner whorls of the umbilicus.

THE PERIWINKLES (*Turbo*, Linn.)—

Comprise all the species with the shell perfectly and regularly turbinate, and of which the aperture is quite round. From a detailed examination of them, they have been greatly subdivided into genera. The *Turbo*, Lam., properly so called, have a round or oval thick shell, with an aperture completed on the side of the spire by the penultimate whorl. The animal has two long tentacula; the eyes raised on [short] pedicles at the exterior base; and, upon the sides of the foot, membranous expansions, either simple or fringed, or furnished with one or two filaments. To some of them those stony thick opercula belong which may be frequently observed in collections, and which were formerly used in medicine under the name of *Unguis odoratus*. Some are umbilicated (*Meleagris*, Montf.), and some are not so (*Turbo*, Montf.).

The *Delphinula* is a shell as thick [and solid] as the Turbo, but subdiscoid, and its aperture is entirely formed by the last whorl, and without a varix. The animal resembles the Turbo. The common species (*Turbo delphinus*, Linn.) takes its name from the branched curved spines that arm the whorls, and which have given rise to a comparison of it to a dried fish.

The *Pleurotoma*, Defrance, are fossil shells with a round mouth, and a narrow deep incision on the outer margin. It is probable that this incision corresponds, as in Siliquaria, with some fissure of the cloak. M. Deshayes reckons already more than twenty-five fossil species. The *Scissurellæ* of M. d'Orbigny are recent species.

The *Turritella*, Lam., have the aperture of Turbo, but the shell is thin and elevated into an obelisk, or turreted.

* Hence Blainville denominates the order *Asiphonobranchiata*.

† Family *Goniostomata* of De Blainville.

The eyes of the snail are on the exterior base of the tentacula; the foot is small. There is a great number of fossil species; and we ought to unite with it the *Proto*, Defr.

The *Scalaria* has the turreted spire of Turritella, with the aperture of Delphinula, but the spire is covered with longitudinal, elevated, rather acute ribs, and the mouth is encircled with a varix. The tentacula and penis of the animal are long and slender. The principal species, the *Turbo scalaris*, Linn., or the *Wentletrap*, has long been famous for the high prices given for a specimen. It is distinguished by its whorls being separate from each other. A small species without this peculiarity (*Turbo clathrus*, Linn.), is common in the Mediterranean.

We may arrange here some terrestrial or lacustrine subgenera, whose shells have an entire roundish operculated aperture. Of this number are the *Cyclostoma*, Lam., distinguished from all others by being terrestrious; and in place of branchiæ, there is a vascular network on the parietes of the pulmonic sac.* In all other respects, Cyclostoma resembles the animals of this family. The spiral shell is finely striated in the direction of its rounded whorls, and, in the adult, the aperture is encircled with a small raised rim, and closed with a round thin operculum. The *Turbo elegans*, Linn., found in woods, under stones and moss, is the type of the genus.

The *Valvata*, Mull., live in fresh water. Their shell is obtusely conical, with a round operculated mouth; and the snail, which has two slender tentacula, and eyes at their inner base, breathes by means of branchiæ. In our native *V. cristata*, Mull., the branchia, in the shape of a miniature feather, protrudes from under the cloak, and floats in the water with a vibratory motion, when the animal wishes to breathe.† On the right side there is a filament that resembles a third tentaculum. The foot is two-lobed in front. The penis of the male is slender, and lies in the respiratory cavity. The shell, scarcely three lines in height, is corneous, obtuse, and umbilicated.

It is necessary to classify here some purely aquatic snails, which formerly made a part of the genus *Helix*, since the shell had the crescent-like aperture that constituted the character of that genus.‡ The three first genera are nearly allied to Turbo. Thus

THE PALUDINA, Lam.—

Have been separated from Cyclostoma because they have no rim or varix round the aperture; because this, as well as the operculum, has a little angle above; and because the animal, having branchiæ, must live in water. It has a very short proboscis, two setaceous tentacula, eyes seated on the external bases, a small membranous fin on each side of the body in front, the anterior margin of the foot lobed, the fin of the right side folded into a small canal to introduce the water into the respiratory cavity, an approach to the siphon of the following family. In the common species (*Helix vivipara*, Linn.), the female is viviparous, and we find the young, in spring, in the oviduct, in all stages of developement. Spallanzani assures us that the young, kept separate from the moment of their birth, can give birth to others without having copulated, as happens with the Aphides. The males are, notwithstanding, as common as the females, their organ issuing from a hole in the right tentaculum, which is thus made larger than the other, and affords a character to know the sexes by.

In the sea there are some shells that differ from Paludina only in their superior thickness. These are

THE LITTORINA, Feruss.

The common species, or Periwinkle, swarms on our coasts, and is eaten. [The *Lacuna* of Turton is a Littorina with a perforation in the pillar.] The *Monodon*, Lam., differs from Littorina§ in having a blunt tooth at the base of the columella, which has in some also a fine incisure. Several are crenulated on the outer lip. The animal is more ornamented, carrying in general on each side three or four filaments as long as the tentacula. The eyes are elevated on pedicles on the outer side of the root of the tentacula. The operculum is round and horny.

Trochus tesselatus, Linn., is an abundant example on the French coast.

THE PHASIANELLA, Lam.—

Have a shell similar in shape to that of Limneus and Bulimus, but the aperture is closed with a calcareous operculum, and the base of the columella is sensibly flattened and without an umbilicus. The shells are much sought after by amateurs, from the beautiful speckled manner in which their various colours are disposed. Their snail has two long tentacula, with the eyes on tubercles at their exterior bases, double lips emarginated and fringed, as well as the lateral fins carrying each three filaments.

[*Planaxis*, Lam., is nearly allied to Phasianella, from which, however, it may be distinguished by the truncation of the anterior part of the pillar. There are six species known, one of which is so common on the shores of the Isle of France that the rocks, in some places, are covered with it.]

* For this reason M. de Ferussac, with Cyclostoma and Helicina, makes a distinct order—his *Pulmonea operculata*, [which has been adopted by Rang and many other systematists; and seems warranted by the anatomy of the former genus given by the Rev. Mr. Berkeley in the *Zool. Journ.* iv. p. 282.]

† Hence Dr. Fleming was induced to institute the order *Cervicibranchia* for the genus, which he afterwards arranged with the Nudibranchia.—ED.

‡ They constitute the family *Ellipsostoma* of De Blainville.

§ Sowerby more properly unites Monodon with Turbo.—ED.

THE AMPULLARIA, Lam.—

Has a roundish ventricose shell with a short spire, like most of the Helices; its aperture is higher than wide, furnished with a [calcareous] operculum, and the columella umbilicated. They live in the fresh and brackish water of hot climates. The animal has long tentacula, and pedunculated eyes. At the bottom of the respiratory sac, by the side of the long branchial comb, there is, according to the observations of MM. Quoy and Gaymard, a large pouch filled with air, and which may possibly be a swimming bladder.

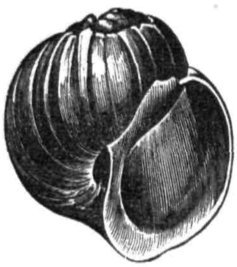

Fig. 174.—Ampullaria rugosa

The *Lanistes*, Montf., are Ampullariæ with a wide spiral umbilicus.—The *Helicina*, Lam., from the shell, would seem to be Ampullariæ with the rim of the aperture reflected. When this rim is sharp, the shells are *Ampullines*, Blainv., and when it is blunt, the *Olygiræ* of Say. There is one species (*Helicina neritella*, Lam.) remarkable for a white shelly edge on the inner side of the operculum. It appears that the organs of respiration are similar to Cyclostoma, and that the animals can live in the open air. [The Helicinæ are land shells. Mr. Gray has given a monograph of the genus in the 1st vol. of the *Zoological Journal;* but since its publication, the number of species has been doubled.]

THE MELANIÆ—

Have a thicker shell, with the aperture deeper than wide, which expands at the part opposite the spire. The columella has neither fold nor umbilicus. The spire varies greatly in its length. They live in rivers, but there is no species in France. The animal has long tentacula, and the eyes are placed about a third way up on their outer side.

The *Rissoa*, Freminv. (*Acmea*, Hartm.) differs from Melania in having the rim of the aperture united all round. [" All we have met with are littoral shells, and several species abound on our shores."—*Sowerby*.—*Melanopsis*, Ferussac, with nearly the same form as Melania, has a callosity at the columella, and a vestige of an emargination near the base of the aperture, indicating a relationship with Terebra. The *Pirena*, Lam., have not merely this sinus, but another on the opposite side. Like the Melania, the two last subgenera live in the rivers of the south of Europe, and of warm countries, [" and yet most of the fossil species are found in beds that are considered by geologists, in this country, to be of marine formation."—*Sowerby*.]

We incline to refer to this place in the system two genera separated from the Volutes, and which have a considerable similarity to Auricula, but are operculated, and have only two tentacula. First, *Acteon*, Montf., (*Tornatella*, Lam.), with a convolute shell; and, secondly, *Pyramidella*, Lam., with a turreted shell, whose columella is obliquely twisted and plaited.

THE JANTHINA*, Lam.—

Is widely separated from all that precede by the form of the animal. The shell has some resemblance to our land snails, but the aperture is angular at its lower part and at its outer side, where, however, the angle formed by the union of the upper and lower halves of the outer lip, is much rounded in most of the species, and somewhat so in the common one: the columella straight and elongated, the inner lip turned back over it. The animal has no operculum, but carries under its foot a vesicular organ, like a congeries of foam-bubbles, of solid consistency, that prevents creeping, but serves as a buoy to support it at the surface of the water. The head is a cylindrical proboscis; and is terminated with a mouth cleft vertically, and armed with little curved spines: on each side of it is a forked tentaculum. The shells are of a violet colour; and when the animal is irritated it pours forth an excretion of deeper blue to tinge the sea around it.

The *Litiopa*, Rang, is a small conoid shell without an operculum, the body-whorl larger than the spire, and the aperture entire. The animal lives on the gulf-weed, whence it can suspend itself by a thread like a spider from a ceiling; and by the same thread it can remount at pleasure to the surface of the weed.]

THE NERITA, Linn.—

Are shells with the columella in a straight line, which renders their aperture semicircular or semielliptical. It is generally large in proportion to the shell, but always closed perfectly with an operculum. The spire is almost obsolete, and the shell semi-globular.†

Naticæ, Lam., are Neritæ with an umbilicus. The animal of such as are known has a large foot, simple tentacula, the eyes sessile at their bases, and a horny [or shelly] operculum. [In *Neritopsis*, Sowerby, there is a broad notch or sinus in the columella, which distinguishes it from Natica and Nerita, whose forms it seems to combine in itself.]

* M. de Blainville makes this genus his family *Oxystoma*. † The genus *Nerita*, Linn., constitute the family *Hemicyclostoma* of Blainville.

Nerita, Lam. (*Peloronta*, Oken), has no umbilicus. Their shell is thick, the columella toothed, the operculum calcareous. The eyes of the animal are supported on pedicles at the sides of the tentacula; and the foot is moderate in size. There is but slight reason to distinguish among them the *Velates*, Montf., where the side of the columella is covered with a thick, swollen, calcareous layer; and the *Neritina*, Lam., in which the columella is toothless, and the animals are inhabitants of fresh waters. Some have, however, a delicately toothed columella, and among these is one whose spire is armed with long spines, (*Clitho*, Montf.). [The species of Neritæ are very numerous. M. Lesson has brought one from Australia, where it lives abundantly upon trees! This fact ought to make us more than ever wary of separating the marine from the fluviatile species. Indeed, some real Neritinæ can live both in fresh and salt water, and others are altogether marine.]

Recent observations induce us to arrange near to the Trochoides

THE SECOND FAMILY OF THE PECTINIBRANCHIATA,—

THE CAPULOIDES,*—

Which comprises five genera, four of which are dismembered from Patella. All of them have a widely open shell, scarcely turbinate, without an operculum, or emargination or canal. The animal is male and female, and resembles the other Pectinibranchiata. Their branchial comb is single, laid across the vault of the cavity, and its filaments are often very long.

CAPULUS, Mont. (*Pileopsis*, Lam.)—

Have a conical shell, with the summit recurved a little in spiral, whence they were for long placed with the Patellæ. The branchiæ are in a series under the anterior margin of their cavity; the proboscis is of considerable length; under the neck is a much plaited membranous veil; there are two conical tentacula with the eyes at their base on the outside.

Hipponyx, Defr., appear from their shell to be fossil Capuli, but are very remarkable for the base of calcareous layers on which they rest, and which has probably been excreted by the foot of the animal. [Hipponyx is a truly bivalve shell.]

CREPIDULA, Lam.

Shell oval [variable], with an obtuse point obliquely inclined backwards towards the margin: the under-side is generally concave, and the inner lip forms a broad, flattish, sharp-edged, toothless, horizontal plate, which about half covers the aperture. The abdominal sac containing the viscera is upon this plate, the foot under it, the head and the branchiæ in front. The branchiæ consist of a series of long filaments attached under the anterior margin of the branchial cavity. Two conical tentacula bear the eyes at their exterior bases.

Pileolus, Sowerby, seem to be Crepidulæ, of which the transverse plate occupies half of the aperture, but their shell has a greater resemblance to Patella. The few species known are fossil.

Septaria, Ferus. (*Navicella*, Lam.), resemble the Crepidula, excepting that their summit is symmetrical, and turned down on the posterior margin, and their horizontal plate projects less. The animal has, moreover, a testaceous plate of an irregular shape, attached horizontally upon the superior surface of the muscular disk of the foot, and covered by the abdominal sac, which rests in part above. It is, probably, the analogue of an operculum, but does not fulfil its office, being in some degree internal. The animal has long tentacula, and at their outside are peduncles to support the eyes. They live in the rivers of warm countries.

CALYPTRÆA, Lam.

Shell conoid, the cavity furnished with a lateral internal appendage, very variable in form, which is as it were the beginning of a columella, and is interposed in a fold of the abdominal sac. The branchiæ are composed of a range of numerous hair-like filaments. Some have the appendage adhering to the bottom of the cone, folded itself into a cone, or tube, and descending vertically. Others have it placed almost horizontally, adhering to the sides of the cone, which is marked above with a spiral line, that gives to their shell some relation to that of the Trochus.†

SIPHONARIA‡, Sowerby.

Dismembered from Patella, to which in general form and appearance it very nearly approaches, but its margin is a little more prominent on the right side, and it is hollowed underneath with a shallow groove which opens at this prominence, and with which a lateral hole in the cloak corresponds, to intro-

* M. de Blainville inserts the most of them among his *Paracephalophora hermaphrodita*, Fam. *Calyptracea*, but they seem to me to be all dioicous. [It is necessary to arrange with them the *Lottia* of Gray, which has a shell almost identical with that of Patella, but the animal is pectinibranchous. We have at least one native species, (*Pat. Clealandi*).]

† [Mr. Broderip has described many species in the 1st vol. of the *Trans. of the Zool. Society*, accompanied with beautiful figures; and Mr. Owen has given an excellent anatomy of the genus in the same work.]

‡ Apparently the same as the *Gadinia* of Gray.—*Phil. Mag.* April, 1824.

duce the water to the branchial cavity placed upon the back, and closed in every other place. The respiratory organ consists in a few small leaflets, attached in a transverse line to the bottom of that cavity. The animal appears to have no tentacula, but only a narrow veil upon the head. There are species in which the shell shows no appearance of the groove, and would perfectly resemble a Patella were it not that its vertex is turned backwards. [We must observe, says Rang, that we have seen young Patellæ to have the character of Siphonaria, and to preserve traces of it at a more advanced age. it is only then provisionally that we adopt this genus, and assign it a place among the *Inferobranchiata.*]

SIGARETUS, Adans.

The shell is flattened, with an ample round aperture, and an inconsiderable spire, whose whorls enlarge very rapidly, and are visible on the inside. It is hidden during life in the fungous shield of the animal, which projects considerably beyond it, as well as the foot, and is the true mantle. We observe in front of this mantle an emargination and a semi-canal, the use of which is to conduct water into the branchial cavity, but which leave no impressions on the shell. The structure indicates a transition to the following family. The tentacula are conical, with the eyes at their exterior base: the penis of the male is very large.

There are species on our own coasts. [This remark is erroneous, unless we consider Cuvier's Sigaretus the same as Pleurobranchus. See some remarks on the confusion in the nomenclature of this genus by Mr. Gray, in the *Zool. Journ.* i. p. 428.]

Coriocella, Blainv., is a Sigaretus with a horny and almost membranous shell, like that of Aplysia.

THE CRYPTOSTOMA, Blainv.—

Has a shell very similar to Sigaretus, supported, with the head and abdomen (which it covers), on a foot four times its size, cut square behind, and which produces in front a fleshy oblong part that constitutes nearly one half of its mass. The animal has a flat head, two tentacula, a broad branchial comb on the roof of its dorsal cavity, and the penis under the right tentaculum, but I have not seen any emargination in the cloak.

THE THIRD FAMILY OF THE PECTINIBRANCHIATA,—

THE BUCCINOIDES,*—

Have a spiral shell, the mouth of which has, near the end of the columella, a sinus or canal, for the passage of the siphon or tube formed by an elongated fold of the cloak. The greater or less length of this canal when it exists, the greater or less width of the aperture, and the various forms of the columella, afford characters for a division of the family into genera, which can be grouped in various ways.

THE CONES (*Conus*, Linn.)—

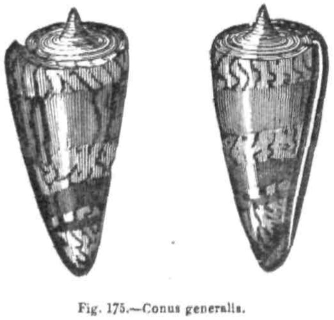

Fig. 175.—Conus generalis.

Are so named from the conical figure of their shells. The spire, either flat or slightly raised, forms the base of the cone, whose apex is at the opposite extremity: the aperture is narrow, rectilinear, or nearly so, extended from one end to the other, without protuberance or fold, either on the columella or the margin. The animal is of a thinness proportioned to the aperture through which it issues: its tentacula and proboscis are much elongated, and we find the eyes near the apex of the former, on the outside: the operculum, seated obliquely on the hinder part of the foot, is narrow, and too short to close the mouth of the shell.

The shells of this genus are in general beautifully coloured, whence it happens that they crowd our cabinets. Our seas produce only a very few species, [of which there is a full enumeration in Lamarck's *Histoire naturelle des Animaux sans vertèbres.*]

THE COWRIES (*Cypræa*, Linn.)—

Have also a [concealed or] very short spire, and a narrow aperture extending from one end to the other; but the shell, which is ventricose in the middle, and almost equally narrowed at both ends, forms

* Coequal with the *Paracephalaphora dioica siphonobranchiata* of Blainville.

† M. de Blainville unites in one family, named *Angyostoma*, the Conus, Cypræa, Ovula, Terebellum, and Voluta. In placing here th genera with a narrow aperture, we do not intend to say that they are nearest in affinity to the preceding family; but we place them first because they exhibit the characters of the siphoniferous tribes in the most distinct manner.

an oval; and its aperture in the adult animal is transversely toothed on each side. The cloak is sufficiently ample to fold over and envelope the shell, which, at a certain age, it covers with a layer of shell of another colour; and from this circumstance, joined to the change which the aperture undergoes, the full-grown shell may be mistaken for another species. The animal has moderate tentacula, with the eyes at their external bases, and a thin foot without an operculum.

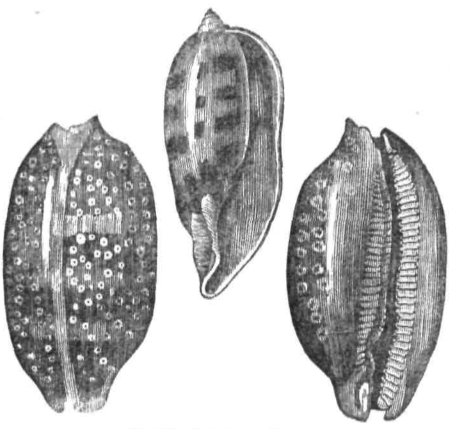

Fig. 176.—Cypræa exanthema

The colours of the shells are very beautiful, and many species are found in our cabinets, though, with very few exceptions, they all inhabit the seas of tropical countries. [Bruguières was of opinion that the animal of the Cypræa, before it arrived at its complete growth, abandons its shell several times, to form another more fitted to its dimensions. This opinion is now relinquished.]

THE OVULÆ, Brug.—

Have an oval shell, with a narrow, lengthened aperture, as in Cypræa, but without teeth on the columellar side; the spire is concealed, and the two ends of the aperture are nearly equally emarginated, or equally prolonged into a canal. Linnæus confounded them with Bulla, from which they were properly separated by Bruguières. Their snail has a broad foot, an expanded cloak, which partly folds over the shell, a moderate and obtuse snout, and two long tentacula, on which we find the eyes at about the third of their length on the outside. Montfort restricts the name *Ovula* to such shells as are transversely denticulated on the outer lip; and he names those in which the two ends of the aperture are prolonged into a canal, and the outer lip is plain, the *Volva.* When this lip is also plain, without a prolongation on each side, he calls the genus *Calpurna.*

TEREBELLUM, Lam.—

Has an oblong [or subcylindrical] *shell, with a narrow aperture, without plaits or grooves, and increasing regularly in width to the end opposite the spire, which is more or less salient, according to the species.* The animal is not known. [On account of its hidden spire, Montfort separates the species named *Convolutum*, by Lamarck, to form his genus *Seraphs*, which seems to be unnecessary.]

THE VOLUTES (*Voluta*, Linn.)—

Vary in the figure of the shell and of the aperture, but are recognized by the emargination without a canal which terminates it, and by the oblique plaits of the columella.

Bruguières first separated from them the *Oliva*, so named from the oblong or elliptical form of the shell, whose mouth is straight, long, and sinuated opposite tothe short spine, and the plaits of the columella are numerous and similar to striæ. The whorls are separated from each other by a narrow groove. These shells do not yield in beauty to the Cowries. Their animal has a large foot, the anterior part of which (in advance of the head) is separated by an indentation on each side: the tentacula are slender, and the eyes are on their side near the middle of their length. The proboscis, the siphon, and penis are tolerably long: they have no operculum. MM. Quoy and Gaymard have observed at the posterior part of the foot an appendage, which is laid in the furrow of the whorls.

The remaining species of the Volutes have been subdivided into five genera by M. de Lamarck. The *Volvaria nearly resemble Oliva in their oblong or cylindrical form; but their aperture is narrow, and its anterior margin* rises even above the spire, which is extremely short. There are one or several plaits on the columella. Their polish and whiteness has induced the natives of some countries to string them into necklaces. There is a small fossil species in the environs of Paris. [According to Sowerby, Volvaria is entirely a fossil genus, of which two species are found in the environs of Paris, and one in the London clay at Hordwell.] *Voluta*, Lam., has an ample aperture, and a columella marked with some large plaits, of which the inferior is the strongest. Their spire varies much in its prominence. Some (*Cymbium*, Montf.; *Cymba*, Sowerb.) have the last whorl ventricose: their animal has a large, thick, fleshy foot, without an operculum; and over the head a veil, at the sides of which the tentacula issue. The eyes are seated on this veil, exterior to the tentacula. The proboscis is of considerable length, and the syphon has an appendage on each side of its base. The shells attain a great size, and several are very beautiful. ["The shells are ventricose, light, and buoyant, floating when placed upon their backs on water, and having when so placed a boat-like appearance. Their apex is rude, and without regularity of shape. They are sombre, and, for the most part, uniform in colour. They are covered with a smooth brown epidermis, which is, again, more or

less coated with a vitreous covering or enamel-like glaze, probably secreted by the mantle. The columella is uniformly curved, and it is believed that none of the species have hitherto been found in the New World."—*Broderip.*] [The *Melo*, Broderip, resembles Cymba; but its apex, instead of being shapeless and rude, takes a well-fashioned and spirally-marked form. The colouring of the shell is also more elegant and vivid.] Others (*Voluta*, Montf.) have the last whorl conoid, narrowing at the end opposed to the spire. The foot is less than in the preceding genus. Their shells are often very remarkable for the beauty of the colours and patterns which are painted on their surface. [There is reason to believe that the genera Cymba, Melo, and Voluta, are viviparous.] *Marginella*, Lam., with the form of the Voluta, has the outer lip thickened and revolute. The sinus is slightly marked. According to Adanson, the foot is also less, and has no operculum. The animal can partially cover its shell by raising the lobes of its cloak. The tentacula have the eyes upon the outer side at their base. M. de Lamarck distinguishes among them the *Colombella*, by the more numerous plaits on the shell, and by a swelling of the middle of the outer lip. It appears that there is no operculum. *Mitra*, Lam., has an oblong aperture with some large folds on its columella, of which those next the spire are the largest. Their spire is generally long and pointed. Several species are brilliantly spotted with red upon a white ground. Their animal has a small foot, tentacula of moderate length, with the eyes on the side one-third above the roots, and a moderate siphon; but it will often protrude a proboscis longer than the shell. [The genus *Conohelix*, of Swainson, has a form more conical than the typical Mitræ; but its claim to be a good genus is denied by Sowerby.] *Cancellaria*, Lam.—The last whorl ventricose, and the aperture ample and round, with a plate upon the columella: the spire is prominent, pointed, and the surface marked in general with cancellated striæ. [According to Sowerby, this genus is nearly allied to Purpura.]

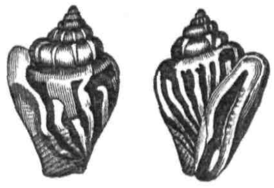
Fig. 177.—Colombella.

THE WHELKS (*Buccinum*, Linn.)*—

Comprise all the shells furnished with an emargination, or short canal, bent to the left, and whose columella is not plaited. Bruguières made four genera of them; viz., *Buccinum*, *Purpura*, *Cassis*, and *Terebra*; which MM. de Lamarck and Montfort have still further subdivided.

Buccinum, Brug., comprises the emarginated shells without any canal, the general form being oval, as well as the aperture. The animals where known have no veil on the head,—a proboscis, two widely separate tentacula with the eyes on their outer bases, and a horny operculum. The siphon is prolonged beyond the shell. M. de Lamarck specially reserves the name *Buccinum* to such as have the columella convex and naked, and the outer lip without ribs or varix. Their foot is moderate in size; their proboscis long and thick, and their penis often excessively large. [The shell of the remarkable genus named *Trichotropis* by Broderip and Sowerby, is turbinated and keeled; its aperture is wider and rather longer than the spire; the base entire: but immediately below the obliquely truncated columella there is an indistinct canal. The shell is thin and delicate, covered with an epidermis forming numerous sharp-pointed bristle-like processes on the edges of the carinæ outside the shell. The horny operculum is much smaller than the aperture. The animal resembles a Buccinum, differing from it principally in having only a very small fold of the mantle to line the nearly obsolete canal of the shell. There is a British species (*T. borealis*).] *Nassa* has the columella covered by a plate more or less thick and broad, and the emargination deep, but without a canal. The animal resembles that of Buccinum, and there are shells intermediate between the two genera. Lamarck names *Eburna* those which join to a smooth shell, without plaits on the lip, a pillar that is deeply and widely umbilicated. In general form their shell has a strong resemblance to the Olives. [There is no operculum.] The animal is unknown. The *Ancillaria*, Lam., has also a smooth shell, and at the base of the columella a striated appendage or varix, without an umbilicus, and without a groove round the spire. The animal, in such species as it has been observed in, is similar to that of Oliva, and has the foot even more developed. The same naturalist unites those which are ribbed in the direction of the whorls, under the generic name of *Dolium*: the lower whorl is very large and ventricose. Montfort again subdivides Dolium into the *Dolium* proper, where the base of the columella is as it were twisted; and into *Perdix*, where it is sharp. Their animal has a very large foot, dilated in front; a proboscis longer than its shell; slender tentacula; eyes at their exterior side near the base; the head without a veil, and the foot without an operculum. *Harpa* is easily recognized by the prominent ribs which cross the whorls, and of which the last forms a rim to the margin of the aperture. The shells are beautiful. The animal has a very large

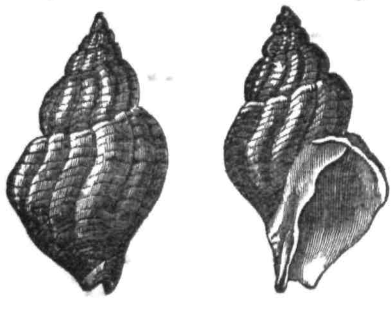
Fig. 178.—Buccinum undatum.

Fig 179.—Ancillaria.

* Forms the family *Entomostoma* of Blainville.

foot, pointed behind, widened in front, where it is marked with two deep emarginations. The eyes are on the sides of the tentacula, near the base. There is no veil nor operculum. (MM Reynaud, and Quoy and Gaymard have observed that, under certain circumstances, the hinder part of the foot is spontaneously amputated.) We recognize the *Purpura*, Brug., by its flattened columella, pointed at the base, and forming there, with the outer lip, a canal excavated in the shell, but not projecting. The species were scattered among the Buccina and Murices by Linnæus. Their snail is like that of Buccinum as now restricted. Some shells similar to Purpura, but in which we notice a spine on the outer margin of the canal, form the genus *Licorna*, Montf. (*Monoceros*, Lam.) Others in which the columella, or at least the lip, is garnished, in the full-grown shell, with teeth that narrow the mouth, constitute the *Sistra* of the former, and the *Ricinula* of Lamarck. The *Concholepas*, Lam., has also the general characters of the Purpura, but the aperture is so enormously large and the spire so inconsiderable, that the shell has the aspect of a Capulus, or of one of the valves of an Arca. The emargination of the mouth has a small tooth on each side of it. The animal resembles that of Buccinum, excepting in the foot, which is enormous in width and in thickness, and which is attached to the shell by a muscle in form of a horse-shoe, as in Capulus. There is a thin, narrow, horny operculum. A species from Peru (*Buccinum concholepas*, Brug.) is the only one known. *Cassis*, Brug.—Shell oblong; the aperture oblong or narrow; the columella covered with a plate as in Nassa, and that plate grooved transversely as well as the outer lip: the emargination ends in a short canal, which is folded and turned up backwards, and to the left. There are often varices. [The shells are called *Helmets* by English collectors, and are in general remarkable on account of their great size.] The animal resembles that of Buccinum, but its horny operculum is toothed, that it may pass between the grooves of the outer lip. Some have the varix of this lip toothed externally near the emargination; and others have it plain. The *Morio*, Montf. (*Cassidaria*, Lam.) are separated from the Cassis because their canal is less abruptly curved back; and they lead us to certain of the Murices. The animal resembles a Buccinum also, but its foot is more developed. [*Oniscia*, Sowerby, is sufficiently distinguished from Cassidaria by its granulated inner lip, its very short, scarcely reflected canal, and its very singular general form, which is oblong or subcylindrical, with an obtuse apex. *Strombus oniscus*, Linn., is the type of the genus.] *Terebra*, Brug., have the mouth, the emargination, and the columella of Buccinum, but their spire is drawn out so as to be turriculated or subulate. [The species are numerous and beautiful.] The *Subula*, Blainv., is distinguished by some difference in the animal, and by the existence of an operculum.

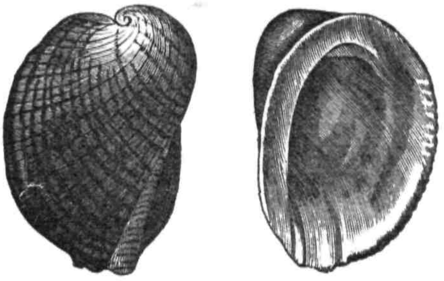

Fig 180.—Concholepas peruvianus.

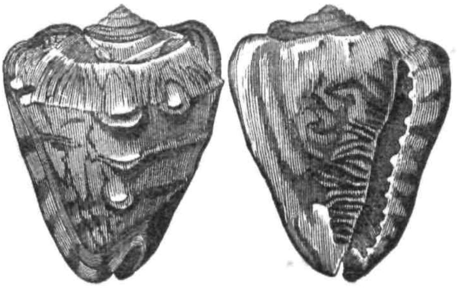

Fig. 181.—Cassis tuberosa.

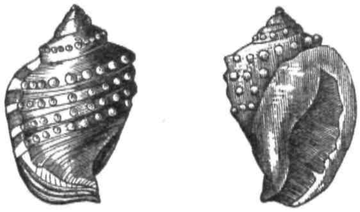

Fig. 182.—Cassidaria echinophora.

THE CERITHIUM, Brug.,—

Dismembered with good reason from the Murex of Linnæus, have a shell with a turriculated spire, an oval aperture, and a short but distinct canal curved to the left and backwards. There is a veil on the head of the animal, two distant tentacula, having the eyes at the side, and a round, horny operculum. Many of them are found in a fossil state.

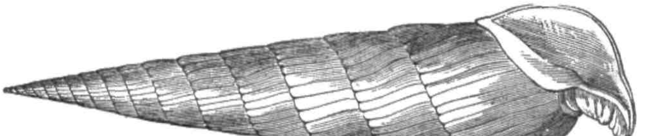

Fig. 183.—Ceritheum.

M. Brongniart has separated from Cerithium the *Potamides*, which, with the same form of shell, have a very short, scarcely emarginate canal, no sinus or gutter near the top of the right lip, and the exterior lip dilated. They live in rivers, or at least at their mouths; and some of them are fossil in formations where there are no other than land or freshwater species.

THE MUREX, Linn.*—

Embraces all shells whose canal is elongate and straight. I have found in the animals of all the sub. genera a proboscis; approximated long tentacula, with the eyes external at their base; a horny oper. culum, and no veil over the head: they otherwise resemble the Buccina, except in the length of the siphon. Bruguières divided them into two genera, subsequently subdivided into others by Lamarck and Montfort.

Murex, Brug., are all shells with a salient straight canal, and with varices across the whorls. M. Lamarck reserves this name specially to those in which the varices are not contiguous, so as to make two opposite rows. If their canal is long and slender, and the varices are armed with spines, they belong to the *Murex* of Montfort. If the varices are merely nodulous, they constitute his *Brontes*. Some, with a canal of moderate length, have projecting tubes between the spinous varices which penetrate the shell; and these are the *Typhis*, Montf. The *Chicoracea* of the same have, instead of spines, the varices garnished with plaited leaves, torn or divided into branches: their canal is long or moderate, and their foliaceous productions vary infinitely in shape and complexity. When, with a moderate or short canal, the varices are only nodulous, and when the base has an umbilicus, the shell becomes an *Aquilla*, Montf. We have several species on our coasts. If there is no umbilicus, that marks the genus *Lotorium*. Lastly, when the canal is short, the spire raised, and the varices simple, the shell is a *Tritonium*. The mouth is generally grooved transversely on both sides. We have some large species in our seas. [The *T. variegatum* is much valued by the inhabitants of some of the South Sea islands.] There are of them some with numerous, compressed, almost membranous varices,—the *Trophones*, Montf.; and in others they are much compressed and very prominent, but few in number.†

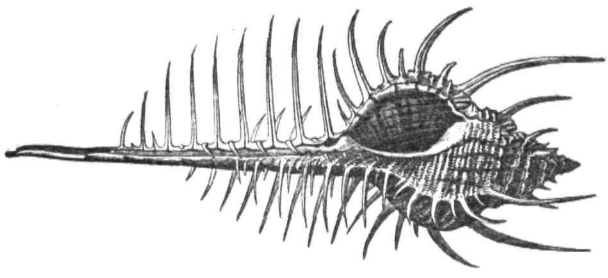

Fig. 184.—Murex tenuispina.

M. de Lamarck separates from all the Murices of Bruguières the *Ranella*. Its character is to have the varices opposite, so that the shell is as it were girded with a border on two sides. Their canal is short, and the surface is roughened only with tubercles. The margins of their aperture are furrowed. The *Apolles*, Montf., are merely umbilicated Ranellæ.

Fusus, Brug., includes all the shells of this family which have no varices. When the spire is prominent, the pillar without plaits, and the margin entire, this is the *Fusus* of Lamarck, which Montfort has still further restricted, for he reserves this name to such as have no umbilicus. The less elongated and more ventricose species gradually approximate to the Buccina in their shape, and where they have an umbilicus, Montfort calls them *Lathires*. The *Struthiolaria* is another subgenus, distinguished by the inner lip being thickened and spreading over the lower part of the last volution and the columella, and in the adult the outer lip is thickened and turned outward,—a character that connects them with the Murex. When the spire is raised, the columella without plaits, and when there is near the top of the aperture, on its outside, a well-marked sinus or fissure, we have the characters of *Pleurotoma*, Lam. When this sinus is wide and touches the spire, some have seized the too slight distinction to make the genus *Clavatula*. When the spire is depressed, and the pillar without plaits, these are the *Pyrula*, Lam., which are either umbilicated or not. Montfort separates from Pyrula the species with a flattened spire, and which are striated within the mouth, to call them the *Fulgur*. They are in some degree Pyrulæ with a plaited columella, and the plaits are sometimes even scarcely perceptible. Amid these dismemberments of the *Fusus*, Brug., we distinguish the *Fasciolaria*, Lam., by some oblique and distinct folds on the columella, near the origin of the siphon.

Turbinella, Lam., are likewise shells with a straight canal, without varices, distinguishable by having [from three to five] prominent, compressed, transverse folds, all nearly equal in size, near the centre of the columella, and which approximates them to the conical Volutæ: in fact, they only differ by the superior elongation of the syphonal canal, [and in having an operculum, as well as a thickish epidermis].

THE STROMBUSIDÆ (*Strombus*, Linn.)—

Comprise the shells with a canal either straight or bent to the right, the external lip of the aperture becoming, in its maturity, more or less dilated, and always marked with a sinus near the siphonal canal, whence the head issues when the animal comes out. In the greater number this sinus is at some distance from the canal.

* Coequal with the family *Siphonostoma* of M. de Blainville.

† It is to be regretted that Cuvier should have given even the appearance of a sanction to these new genera of Montfort.—ED.

M. de Lamarck subdivides these species into two subgenera. His *Stromous* have the outer lip dilated into a wing of more or less expanse, but not divided into digitations. The foot is proportionably small, and the tentacula support the eyes upon a lateral peduncle larger even than the tentaculum itself. The operculum is horny, long, and narrow, resting upon a thin tail. *Pteroceras*, Lam., have the margin of the full-grown shell divided into long, slender digitations, varying in number according to the species. The animal is the same as in Strombus.

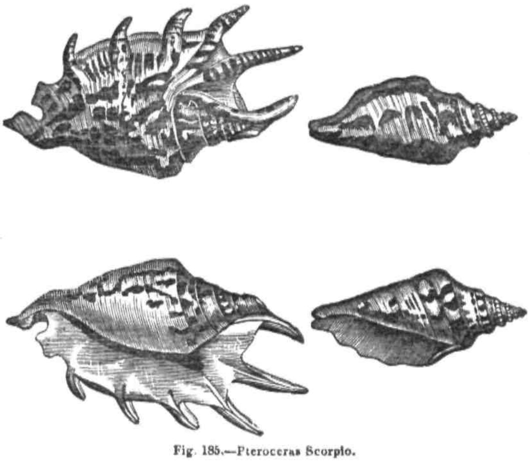

Fig. 185.—Pteroceras Scorpio.

Other Strombusidæ have the sinus contiguous to the siphon. These are the *Rostellaria*, Lam. They have generally a second canal mounting up the spire, and formed by the external lip, and by a continuation of the columella. In some of them the lip is digitated. Their animal resembles that of the Muricidæ; but the operculum is very small. Others have merely denticulations on the lip: their canal is long and straight. Others have the margin entire and plane; and these are the *Hippocrenes*, Montf.

THE SEVENTH ORDER OF THE GASTEROPODES.

THE TUBULIBRANCHIATA.*

They ought to be detached from the Pectinibranchiata, with which they have nevertheless many affinities, because their shell, in the shape of a more or less irregular tube, and only spiral at its apex, is permanently fixed to other bodies. Thus they have not organs of copulation, and must fecundate themselves.

VERMETUS, Adanson,—

Has a tubular shell, whose whorls, at an early age, still form a kind of spire; but they are continued on in a more or less irregularly twisted or bent tube, like the tubes of a Serpula. The shell usually attaches itself by interlacing with others of the same species, or by becoming partially enveloped by lithophytes. The animal, having no power of locomotion, is deprived of a foot, properly so called; but the part which in ordinary Gasteropodes forms the tail, is here turned under, and extends forwards, even beyond the head, where its extremity becomes inflated, and furnished with a thin, [horny, multispiral] operculum. When the animal withdraws into its shell, it is this inflated mass which closes the entrance. It has sometimes different appendages; and the operculum is spiny in certain species.† The head is obtuse, furnished with two tentacula of moderate size, having the eyes on the outside at their base. The mouth is a vertical orifice: under it we see, on each side, a filament which has all the appearance of a tentaculum, but which really belongs to the foot. The branchiæ form a single [pectinated] line along the left side of the branchial ceiling. Its right side is occupied by the rectum, and by the spermatic canal, which is also the oviduct. There is no male organ.

The species are pretty numerous, but ill defined. Linnæus left them among the Serpulæ; and the Vermilia, which Lamarck still allows to stand near Serpulæ, do not differ from the Vermetus. [This remark is erroneous; Vermilia is a true Annelide, and should be left where Lamarck has placed it.]

MAGILUS, Montf.—

Has its tube keeled its whole length. At first it is pretty regularly spiral, and then is extended in a more or less straight line. Although we do not know the animal, it is probable that its place will be found to be near Vermetus. [The shell is found inclosed in madrepores, but not attached to them in any degree. It would appear that when quite young the animal takes up its station in a hollow part of

* [The genera of this order are arranged amongst the *Pectinibranchiata* by Rang.

† [This observation is erroneous, and has probably arisen from mistaking some opercula of Serpulæ for those of a Vermetus.

the madrepore; and, increasing itself in size and length as the madrepore increases around it, it keeps the aperture even with the outer surface of the coral, and thus grows, in some instances, to a considerable length. This singular testaceous parasite is common in the coral rocks of the Isle of France, and its tube sometimes reaches the length of three feet.]

SILIQUARIA, Brug.—

Resembles Vermetus in the head, the position of the operculum, and in the tubular and irregular shell; but there is a fissure on the whole length of the shell which follows its contour, and which corresponds with a similar cleft in that part of the cloak which covers the branchial cavity. Along the whole side of this cleft is a branchial comb, composed of numerous delicate and tubular-like leaflets. Linnæus left these shells also in Serpula; and until a very recent date they were believed to be members of the class Annelides. [The remarkable operculum is similar to the pod of a Medicago, consisting of a spiral lamella rolled five times round an axis like a pulley. This horny lamella is very lustrous underneath, farinaceous or subpubescent above, and subcrenate on the under side of the rim, with short striolæ. It is convex in the centre, and the projection is multilocular, very exactly resembling a *Cristellaria* or *Robulina*.]

THE EIGHTH ORDER OF THE GASTEROPODES.

THE SCUTIBRANCHIATA.*

The order comprises a certain number of Gasteropods having a considerable resemblance to the Pectinibranchiata in the form and position of the branchiæ, as well as in the general form of the body, but they are complete hermaphrodites. Their shells are very open, without an operculum, and the greater number are not in any degree spiral, so that they cover their animals, and particularly the branchiæ, in the manner of a shield. The heart is traversed by the rectum, and receives the blood by the two auricles, as in the majority of the Bivalves.

THE HALIOTIDES (*Haliotis*, Linn.)—

Are the only family of this order in which the shell is turbinated; and from those shells it is distinguished by the excessive amplitude of the aperture, and the flatness and smallness of the spire, which is seen from within. This form has caused it to be compared to the ear of a quadruped.

In the *Haliotis*, Lam., the shell is perforated along the side of the columella with a series of holes; and when the last hole remains incomplete, the shell has the appearance of being emarginate. The snail is one of the most richly adorned of Gasteropods. A double membrane, with a furbelowed margin, and furnished with a double row of filaments, extends, at least in the commonest species, round the foot, and on to the mouth: outside its long tentacula are two cylindrical pedicles, which support the eyes. The cloak is deeply cleft on the right side, and the water, which passes through the holes of the shell, gains access, by the medium of the cleft, to the branchial cavity. Along the margins of the cleft there are also three or four filaments, which the animal can also protrude through the holes of the shell. The mouth is a short proboscis.

Padolla, Montf. [*Stomatella*, Lam.] has an almost circular shell; almost all the holes obliterated; and a deep groove that follows the middle of the whorls, and shows itself exteriorly by a corresponding ridge.

Stomatia, Lam., have a more concave shell, with a more prominent spire, and without holes: they otherwise resemble the Haliotis, and connect that genus with certain kinds of Turbo. The animal is less adorned than Haliotis.†

The following genera, dismembered from Patella, have the shell quite symmetrical, as well as the position of the heart and branchiæ.

FISSURELLA, Lam.—

Have a broad, fleshy disk under the belly, as the Patella; a conical shell placed over the middle of the back, but not covering it completely, and perforated in the summit with a small aperture. which serves both for the passage of the excrements, and of the water necessary to respiration: that aperture penetrates into the cavity of the branchiæ situate over the front of the back, at the bottom of which the anus opens; and this cavity is moreover widely patulous over the head. There is a branchial comb on each

* M. de Blainville unites this and the following order in his subclass *Paracephalophora hermaphrodita*.

† [*Padola* and *Stomatia* (that constitute but one genus, according to Sowerby,) are placed in the order Pectinibranchiata by Rang, where we find also next them the *Velutina* of Flemming, distinguished by its neritoid thin shell with a wide entire aperture, without an operculum His *Stylina* (*Stylifer*, Broderip) has also no operculum, but the spire is pointed and acute. One species lives on the Echinus; another imbeds itself in Starfish]

side of it, and the combs are alike: the conical tentacula have their eyes at their external base: the sides of the foot are garnished with a row of filaments.

Emarginula, Lam., has exactly the same structure as Fissurella; but instead of a hole in the apex, its cloak and shell have a little cleft or emargination on their anterior side, which also penetrates into the branchial cavity. The margins of the cloak envelope and in a great measure cover those of the shell: the eyes are on a tubercle at the outer bases of the conical tentacula; and the sides of the foot are as usual ornamented with filaments.

Parmophorus, Lam. (*Scutum*, Montf.)—As in Emarginula, the shell is covered, in a great measure, by the turned up margins of the cloak: the branchiæ and other organs are the same as in the two preceding genera; but the oblong, slightly conical shell has neither hole nor emargination. [Sowerby unites this with the preceding genus.]

THE NINTH ORDER OF THE GASTEROPODES.

THE CYCLOBRANCHIATA.*

These Mollusks have their branchiæ in the form of little leaflets or pyramids, attached in a circle, more or less complete, under the margins of the cloak, very nearly as in the Inferobranchiata, from which they are distinguished by the nature of their hermaphroditism; for, as in the preceding order, they have no organs for copulation, and impregnate themselves. Their heart does not embrace the rectum, but varies in its position. We know only two genera, whose shell never exhibits even a trace of a spire.

THE LIMPETS (*Patella*, Linn.)—

Have the body entirely covered with a conical shell; and under the margins of their cloak there is a circle of branchial leaflets. The anus and the orifice of the organs of generation are a little to the right above the head, to which there is a thick, short proboscis, and two setaceous tentacula, having the eyes at their exterior bases: the mouth is fleshy, and contains a [very long ribbon-like] spinous tongue, which is directed backwards, and lies folded deep within the interior of the body. The stomach is membranous, and the intestine long, slender, and much convoluted. The heart is in front above the neck, a little to the left. Some species occur in abundance on our shores.

THE CHITONS (*Chiton*, Linn.)—

Have a series of testaceous symmetrical plates set along the back of their cloak, but not occupying all its breadth. The margins of the cloak itself are coriaceous, either naked, or chagreened, or garnished with spines, or hairs, or bundles of bristles. Beneath this margin, on each side, is a row of lamellated branchiæ; and in front, a membranous veil over the mouth holds the place of tentacula. The anus is under the posterior extremity. The heart is situated behind, upon the rectum. The stomach is membranous, with a long convoluted intestine. The ovary lies above the other viscera, and appears to open upon the sides by two oviducts.

There are some small speceies on our shores; but in the seas of tropical countries they attain a much greater size. (The *Chitonellus*, Lam., distinguished by the valves being so small as only partially to cover the cloak, should be re-united to Chiton, which, in the system of Blainville, forms a separate class, named *Polyplaxiphora*, and which, he supposes, leads the way to the Articulated Animals.)

THE FOURTH CLASS OF MOLLUSCA.

THE ACEPHALES.†

The Acephales have no apparent head, but a mouth only, concealed in the bottom or between the folds, of their cloak. The latter is almost always doubled in two, and incloses the body as a book is inclosed between its covers; but it frequently happens

* In the system of Blainville the Cyclobranchiata is an order that embraces the Doris. With the last three genera of the preceding order, and with the Patellæ, he makes his order *Cervico-branchiata*, divided into the *Retiferes* and *Branchiferes*: the Retiferes are the Patellæ; for he supposes that they breathe by means of a vascular network in the cavity situated above the head I have not been able to discover it, nor indeed to see any other organ of respiration except that of a cord of leaflets which encircles the body under the margins of the cloak.

† M. de Blainville unites my Acephales and Branchiopodes in one class, his *Acephalophora*.

that, in consequence of the two lobes uniting in front, the cloak forms a tube, or a sac when it is only closed at one end. This cloak is generally provided with a calcareous bivalve, and sometimes multivalve, shell; and in two families only is it reduced to a cartilaginous, or even membranous nature. The brain is over the mouth, where we also find one or two other ganglia. The branchiæ usually consist of large lamellæ, covered with vascular network, under or between which the water passes: they are more simple, however, in the genera without a shell. From these branchiæ the blood proceeds to a heart, generally single, which distributes it throughout the system, returning to the pulmonary artery without the aid of another ventricle.

The mouth is always toothless, and can only seize upon such particles as the water floats within reach. It leads into a first, and sometimes a second, stomach: the intestine varies much in length. The bile is poured, generally by several pores, into the stomach, which the liver surrounds. All fecundate themselves; and in several of the shelled species the young, which are innumerable, are retained for some time between the laminæ of the [external] branchiæ before they are expelled.* All the Acephales are aquatic.

THE FIRST ORDER OF THE ACEPHALES.

THE TESTACEOUS ACEPHALES† (OR A. WITH FOUR BRANCHIAL LEAFLETS).

They are beyond comparison the most numerous. All bivalve shells, and some kinds of multivalves, belong to them. Their body, which includes the liver and the viscera, is placed between the two layers of the cloak; and in front, still between the same layers, are the four branchial leaflets, regularly striated crosswise by the vessels. The mouth is at one extremity, the anus at the other. The heart is towards the back. The foot, when there is one, is attached between the four branchiæ. There are four triangular laminæ at the sides of the mouth, which are the extremities of two lips, and are used as tentacula. The foot is merely a fleshy mass, moved by a mechanism similar to that of the tongue of mammiferous animals: it has its muscles fixed in the bottom of the valves of the shell. Other muscles, which form sometimes one, sometimes two masses, go straight across from one valve to the other, to keep them closed; but when the animal relaxes these muscles, an elastic ligament situated behind the hinge opens the valve by its contraction.

A considerable number of Bivalves possess what is called a *byssus*, that is, a bundle of more or less delicate filaments issuing from the base of the foot, and by means of which the animal fixes itself to foreign bodies. It employs the foot to guide the filaments to the proper place, and to glue them there: and it can reproduce them when they have been cut away; but nevertheless their true nature is not yet well ascertained. Reaumur believed them to be spun from a secretion, and moulded in the groove of the foot. Poli thinks them to be merely prolongations of tendinous fibres.

The shell consists of two valves connected by a hinge, which is sometimes simple, and sometimes composed of a greater or less number of teeth and laminæ, that are received into corresponding sockets and cavities. In a few genera, some supernumerary pieces are laid over the hinge. In general the valves have, leaning over the hinge, a prominent [subspiral] part, which is named the summit, or the *nates*.

In the greater number the valves close perfectly when the animal chooses to draw them

* Some naturalists, as Jacobson, have maintained that the minute bivalves which, in certain seasons, load the external branchiæ of the freshwater Mussel, are not the fœtal young, but parasites of different species. This opinion is now generally considered as erroneous.

† The class *Conchifera* of M. de Lamarck.

together; but there are several which always gape, even when brought as nigh together as possible, either at one or at both ends.

THE FIRST FAMILY OF THE ACEPHALA TESTACEA,—

THE OYSTERS,—

Have the mantle open, with neither tubes nor particular apertures. They have no foot, or only a very small one, and are for the most part fixed either by [cementation of] their shell, or by their byssus, to rocks and to other submarine bodies. Those which are free can move only by squirting out the water by a sudden closure of the valves.

Their first section has but one muscular mass passing from one valve to the other, as we see by the single impression left upon the shell.

It is supposed that we ought to arrange here certain fossil shells, whose valves do not seem to have been connected by a ligament*, but to have covered each other like a vase and its lid, and to have been held together by the muscles only. They form the genus *Acardium*, Brug., or *Ostracite*, La Perouse, of which De Lamarck makes the family *Rudistes*. The shells of it are thick, and of a solid or porous texture. We now distinguish in it the *Radiolites*, Lam., whose valves are striated from the centre to the circumference. One of them is flat, and the other thick, nearly conical, and fixed. The *Spherulites*, Lametherie†, with the valves roughened with foliations that rise up unequally. And it is guessed we may place here the *Calceolæ*‡, of which one valve is conical, but free, and the other flat, or even somewhat concave, so that they call to recollection the figure of a shoe: and the *Hippurites*, with one valve conical or cylindrical, that has on its inside two obtuse longitudinal crests: its base appears even to have been divided into several chambers by transverse partitions; the other valve forms, as it were, a lid. The *Batolithes*, Montf., are cylindrical and straight Hippurites; they are often very long; but there remains much uncertainty on the nature of all these fossils.

As to the Testaceous Acephales, known in a living state, Linnæus had united under the genus

OSTREA (the Oysters)—

All those which had neither teeth nor transverse laminæ in the hinge, the valves being held together by a ligament lodged in a little cavity on both sides.

The *Ostrea*, Brug., has the ligament as just described, and their shells are irregular, inequivalved and foliated. They are affixed to rocks, to stakes, and even to one another, by the most convex of the valves. The animal (*Peloris*, Poli) is one of the simplest of bivalves: we observe on it nothing remarkable but a double series of ciliæ round the margin of the cloak, which has the lobes united only above the head near the hinge: there is no appearance of a foot. Every one is familiar with the common Oyster (*O. edulis*, Linn.), which is fished and reared in artificial beds. Its fecundity is as astonishing as its taste is agreeable. [Poli says that the ovaries of a single oyster contain 1,200,000 ova.] Among the species of neighbouring countries we may notice the *Os. cristata* of the Mediterranean; among those of distant lands, the *Os. parasitica*, which fixes itself upon the roots of the mangroves and other trees that grow within the reach of the salt water; and the *Os. folium*, which is attached by the denticulations on the back of its convex valve, to the branches of the Gorgonia and other lithophytes.

M. de Lamarck separates, under the name of *Gryphæa*, certain Oysters, principally fossil, the apex of whose most convex valve projects much, and is either hooked or in some degree spiral. The other valve is often concave. The greater number of the species appear to have been free, but some of them have been seemingly attached by their hooked apices. We know only one recent species (*Griph. tricarinata*). [Sowerby reunites Gryphæa to Ostrea.]

The Clams (*Pecten*, Brug.) have been properly removed from the Oysters, although they have a similar hinge. They are easily distinguished by their inequivalve semicircular shell being almost always regularly marked with ribs, which radiate from the summit of each valve to the circumference, and furnished with two angular productions called *ears*, that widen the sides of the hinge. The animal (*Argus*, Poli) has a small oval foot supported on a cylindrical peduncle, in front of an abdomen in form of a sac hanging between the branchiæ. In some species, known by the strong sinus under their anterior ear, there is a byssus. The others are not adherent, and can even swim with considerable velocity, by flapping their valves together. The cloak is surrounded with two rows of filaments, several of those of the exterior row being terminated by a little greenish globule [with a metallic lustre]. The mouth is garnished with many branched tentacula instead of the four usual labial laminæ. The shell of the clams is often coloured in a lively manner, [and many species are remarkable for the difference in colouring

* [M. Desmoulins has endeavoured to prove that these shells form a class intermediate between the shelless Acephales and the Cirrhopodes. Deshayes, on the contrary, asserts that they are true Bivalves, allied to Chama. Blainville and Rang collect them into a distinct order of Bivalves, under the name of Rudistes.

† *Spherulites* now embraces the *Radiolites* and *Birostrites* of Lam., with *Jodamiæ* of Defrance.—ED.

‡ [Sowerby and Rang maintain that Calceola is much more nearly allied to Terebratula.]

observable in the two valves.] The large species of our coasts (*Ostrea maxima*, Linn.), is the Pilgrim's shell, [worn in front of the hat by those who had visited the shrine of St. James in the Holy Land.] It is eaten.

The Limæ (*Lima*, Brug.) differ from the Pectens in having a more elongated shell, with shorter ears, and a greater inequality of the sides. The majority have the ribs raised into scales. The valves cannot be closed in the living state, and the cloak is ornamented with a vast number of filaments of different lengths, without tubercles; and further within there is a broad fold which closes the gape of the shell, and even forms a protuberant veil. The foot is small, and the byssus inconsiderable. The Limæ swim rapidly, by flapping their valves. One species in the Mediterranean, of a pure white colour (*Ostrea Lima*, Linn.), is eaten.

Pedum, Brug.—The shell is similar to Lima, but the valves are unequal, and the most convex only has a deep sinus for the byssus. The animal also is very like that of Lima, but its cloak has only a single row of small slender tentacula. Its byssus is larger. The one species known is from the Indian sea.

Certain fossils may be placed here which have the hinge, ligament, and central muscle of the Ostreæ, Pectines, and Limæ, but are distinguished by some peculiarities of the shell. The *Hinnites*, Defr., seem to be Oysters, or Clams, with small ears and adherent shells, irregular and very thick, especially the convex valve. There is a fossa at the hinge for the ligament. (Four *recent* species of this genus have been described.) The *Plagiostomes*, Sower., have the oblique shell of the Limæ, flattened on one side, very minute ears, the valves more ventricose, striated, without scales, and the outlet of the byssus less. They are found in formations older than the chalk. The *Pachytes*, Defr., have nearly the figure of the Pectines, a regular shell with small ears; there is a transverse flat space between their summits, which has a strong triangular emargination in one of the valves, through or in which the ligament passes or is lodged. The *Dianchores*, Sower., have unequal oblique valves, one of them adherent and perforated in the summit, the other free and eared. The *Podopsides*, Lam., have regular striated valves, without opercula: one has the apex more prominent than the other, truncated and adherent; this apex is often very thick, and forms a kind of stalk to the shell. (M. de Blainville regards the preceding four genera as nearer allied to Terebratula; and M. Deshayes, on the contrary, approximates them to Spondylus.)

Although multivalve, we should approximate

THE ANOMIÆ, Brug.,—

Fig. 186.—Anomia ephippium

To the Oysters. They have two thin, unequal, irregular valves, the flattest of which is deeply notched on the side of the ligament, which is similar to that of the Ostrea. The greater part of the central muscle traverses this opening, to be inserted into a third plate, that is sometimes calcareous and sometimes horny, by which the animal adheres to foreign bodies; and the remainder of the muscle serves to join one valve to the other. The animal (*Echion*, Poli) has a small vestige of a foot, similar to that of a Pecten, which glides between the emargination and the plate that closes it, and perhaps serves to direct water to the mouth, which is adjacent. Their shells are found attached to various bodies, like Oysters. They are found in every sea.

[*Placunomia*, Sowerby, is the link which connects Anomia with the following genus. With an arrangement of the hinge, approaching very nearly to that of Placuna, we have the distinguishing organization of Anomia, while the external appearance of the shell, especially if viewed in water, bears the strongest resemblance to a Plicatula, or some of the plicated Oysters. The organ of adhesion resembles that of Anomia, but is inserted between the laminæ of the internal surface of the lower valve, above the muscular impression, and below the hinge, and passes out into an external, irregular, somewhat longitudinal superficial fissure, or cicatrix, narrowest at the hinge margin, and which it entirely fills to a level with the surrounding surface of the shell. Three species are known, natives of the tropical seas.]

The *Placuna*, Brug., is affined to the Anomiæ, and, like them, have thin, unequal, and often irregular valves, but neither are perforated. On one of these valves, near the hinge, we perceive two prominent ribs, forming a triangle whose apex is towards the hinge. The animal remains unknown.

SPONDYLUS, Linn.

These have a rough and foliated shell, like the Oysters, and frequently spiny, but their hinge is more complicated, for, besides the fossa for the ligament, there are two teeth in each valve that enter into fossæ in the opposite valve respectively: the two middle teeth belong to the most convex valve, which is usually the left, and has, behind the hinge, a projecting flattish beak, as if it had been sawed. Like the Pectines, the margins of the cloak of the animal are garnished with two rows of tentacula, and in the outer row there are several terminated with coloured tubercles: in front of the abdomen is a vestige of a foot, under the guise of a broad radiated disk with a short pedicle, and capable of contraction and elongation. From its centre there hangs a thread terminated with an oval mass, the use of which is unknown. The Spondyli are eaten like Oysters. Their shells are very often vividly coloured. They

adhere to all sorts of bodies, [and their form is generally modified by the surface of the objects on which they grow].

M. de Lamarck separates from the Spondylus his *Plicatula*, from having no external area, or disk, between the beaks; and flat, almost equal, irregular, plaited and scaly valves, as in many Oysters. [*Sp. plicatus*, Gmel., is the type.]

MALLEUS, Lam.—

Has a simple fossa for the ligament, as in Ostrea, with which genus Linnæus left this one, and the more so as the shell is also inequivalve and irregular, but it is distinguished by an emargination on the side of the ligament for the passage of a byssus.

The best known species (*Ostrea malleus*, Linn.), a rare and dear shell, has the two sides of the hinge extended so as to form something like the head of a hammer, while the valves, elongated in a transverse direction, represent the handle. It inhabits the Archipelago of India. Other species, which are, perhaps, but the young of the Malleus, have no hammer-head, and these we must be careful not to confound with the Vulsellæ.

VULSELLA, Lam.—

Has in the hinge, on each side, a little lamina projecting inwards, and it is from one of these laminæ that the ligament, similar in other respects to that of the Oyster, is stretched to the other. On the side of the lamina is a sinus for the egress of the byssus. The shell is elongated in a direction perpendicular to the hinge. The species best known inhabits the Indian Ocean.

PERNA, Brug.—

Has across the hinge several parallel fossæ opposed to each other in the two valves, and lodging as many elastic ligaments: their shell is irregular and foliated, like the Oysters, and has on the anterior side, underneath the hinge, an emargination, through which the byssus passes. Linnæus left them also among his Ostreæ. [The recent species are brought from the Indian Ocean, and from New Holland.]

There has been recently separated from Perna, the *Crenatulæ*, Lam., which, instead of transverse fossæ on a broad hinge, have little oval ones quite on the margin, where they occupy little breadth. It does not appear that there is any byssus. We find them often buried in sponges. To the Pernæ, it is supposed, we must approximate some fossils which have more or less numerous fossæ in the hinge answering to one another, and appearing also to have given attatchment to ligaments. Thus the *Gervilliæ*, Defr., have a shell almost similar to Vulsella, but with a hinge in some degree double; the exterior with opposed fossæ receiving as many ligaments, and the interior garnished with very oblique teeth on each valve. We find the casts of them with Ammonites in compact limestone. [Many species have occurred at various geological periods from the lias upward, to the baculite limestone of Normandy.] The *Inoceramus*, Sower., is remarkable for the elevation and inequality of the valves, of which the summit is hooked near the hinge, and whose texture is lamellated. The *Catilles*, Brongn., have, independently of fossæ, for the ligament, a conical furrow drawn in a varix, which is bent at a right angle to form one of the margins of the shell. The valves are nearly equal, and of a fibrous texture. They appear to have had a byssus. The *Pulvinites*, Defr., have a triangular regular shell, and its fossæ, few in number, diverge within from the summit. Their casts are found in chalk.

The second subdivision of the Ostracea, as well as almost all the bivalves which follow, besides the single transverse [or adductor] muscle of the preceding genera, have another muscle going from one valve to the other, and placed in front of the mouth. It is apparently in this subdivision that we must place

[THE MULLERIA, De Fer.,—

One of the most singular and rare of known genera. It is remarkable as being intermediate in its structure between Ætheria and Ostrea, and as apparently connecting the regular freshwater bivalves with the irregular marine bivalves (Ostreæ), and with the genus Ætheria, inasmuch as in the sinus at the posterior extremity of the ligament it resembles the Naiades and the Ætheriæ; and in its single muscular impression, as well as its general form, it approaches to Ostrea.]

ETHERIÆ, Lam.—

Are large inequivalved shells, as, or even more, irregular than the Oysters, without teeth to the hinge, and where the ligament, in part external, exists also interiorly. They differ from the Ostreæ in having two muscular impressions. It is not ascertained that their animal produces a byssus. They have lately been discovered in the Upper Nile.

AVICULA, Brug.—

Has a shell with equal valves, and a rectilinear hinge, often extended into wings on each side, furnished with a narrow, elongated ligament, and sometimes with small denticulations on that side which is next

the mouth of the animal. The anterior side, a little under the angle of the side of the mouth, has a notch for the byssus. The anterior adductor muscle is as yet excessively little. When the ears are less prominent, the species have been named *Pintadines*, Lam. (*Margarita*, Leach).

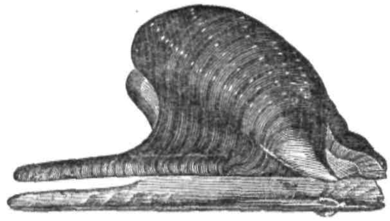

Fig 187.—Avicula macroptera.

The most celebrated is the Pearl-mussel (*Mytilus margaritiferus*, Linn.) Its nacred interior is employed in all sorts of fancy-work, and the orient-pearls, fished for by divers, chiefly at Ceylon, at Cape Comorin, and in the Persian Gulf, are but excretions of it. The name of *Avicula* is given to such species as have the ears more pointed, and the shell more oblique. There is in the hinge in front of the ligament, a vestige of a tooth, whose first trace is indeed to be detected in the Pentadines. The *Mytilus hirundo*, Linn., is an example from the Mediterranean, remarkable for its lengthened auricles: its byssus is large and strong, and has some resemblance to a little shrub.

THE PINNÆ, Linn.—

Have two equal wedge-shaped valves, which are closely united by a ligament along one of their sides. The animal (*Chimæra*, Poli) is elongated in the same direction as the shell, as well as its lips, its branchiæ, and all the other organs. Its cloak is closed on the side of the ligament; its foot is of the shape of a conical little tongue, and marked with a groove; there is a small transverse muscle in the acute angle of the valves, near which the mouth is situated, and a very large muscle at their widest part. On the side of the anus, which is behind this large muscle, there is attached a conical appendage, peculiar to this genus, and capable of inflation and elongation, but of the use of which we are ignorant.

The byssus of several species is as fine and brilliant as silk, and is used in weaving precious stuffs. The chief is the *Pinna nobilis*.

THE ARCACEÆ (*Arca*, Linn.)—

Have the valves equal and transverse, that is to say, the hinge occupies the longest side. It is furnished with a great number of small teeth, interlocking with each other; and with two nearly equal adductor muscles inserted towards the two extremities of the valves.

The Arcæ, properly so called (*Arca*, Lam.), have a straight hinge, and the shell is elongated in a direction parallel to the hinge. The apices of the valves are generally protuberant, and curved towards the hinge, but widely apart. The valves do not meet in the middle, because the animal (*Daphne*, Poli) has in front of the abdomen a process of a horny substance, or a tendinous ribbon, in lieu of a foot, which passes out thence, and by which the animal is affixed to submarine bodies. These shells reside near the shore in rocky places. They are usually covered with a velvety epidermis. They are in little request for the table. There are some species in the Mediterranean; and a great number of fossil species, particularly in Italy, in depositions anterior to the chalk. M. de Lamarck separates, under the name of *Cucullæa*, some Arcæ in which the teeth at the ends of the hinge assume a longitudinal direction. [In Cucullæa the two valves are not exactly alike, and there does not appear to be a byssus, whence Sowerby doubts the propriety of arranging this genus with the Arcaceæ.] We ought probably to separate also such species as have well-marked ribs, and whose valves meet closely and completely, for there is thus reason to believe that the animal is not fixed, and may rather resemble that of the Pectunculus. There is assuredly still greater reason to separate the *Arca tortuosa*, Chem., because of its peculiar figure, and its unequally oblique valves. (It is the type of the genus *Trisis* of Oken.)

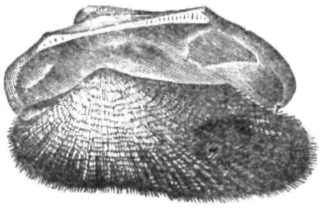

Fig. 188.—Arca barbata.

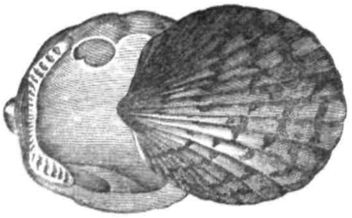

Fig. 189.—Pectunculus

PECTUNCULUS, Lam.—

Has the hinge in a curved line, and the shell of a lenticular form. The valves close exactly, and their apices are near each other. The animal (*Axinea*, Poli) has a large compressed foot, with a double lower margin, and is hence capable of creeping. It lives in sand. We have some native species.

NUCULA, Lam.—

Has the teeth of the hinge in a broken line. The form of the shell is elongated and narrowed towards the posterior end. We do not know the animal, but it is probably not much unlike that of the preceding genus.

For a long time we have placed here the *Trigoniæ*, Brug., so remarkable for their hinge, which is furnished with two plates en chevron, crenulated on both surfaces, and each penetrating into two cavities, or rather between four plates of the opposite side, similarly crenulated on their internal surfaces. From the marks on the inside of the valves we inferred that the animal had not tubes, of any length at least; and MM. Quoi and Gaymard having discovered it alive, we find, in fact, that, like the Arcaceæ, it has an open cloak without any separate orifices, not even one for the anus. Its foot is large, truncate, and hooked at its anterior part. The recent Trigoniæ resemble the Cockles in the figure of their shell, and in the manner in which it is ribbed. Their interior is nacred. The fossil Trigoniæ are considerably different. Their shell is flattened on one side, oblique, longest in the direction perpendicular to the hinge, and crossed in the contrary direction by series of tubercles.

THE SECOND FAMILY OF THE ACEPHALA TESTACEA,—

THE MYTILACEÆ,—

Has the cloak open in front, but with a separate aperture for the passage of excrements. All of them have a foot with which they crawl, or at least draw out, direct, and fix the byssus. They are known to the vulgar by the name of *Mussels*.

MUSSELS, properly so called (*Mytilus*, Linn.),—

Have a closed, triangular shell, with equal ventricose valves. One of the sides of the acute angle forms the hinge, and is furnished with a long, narrow ligament. The head of the animal is in the acute angle; the other side of the shell, which is the longest, is the anterior one, and allows the passage of the byssus; it terminates in a rounded angle, and the third side ascends towards the hinge, to which it is joined by an obtuse angle; near this is the anus, opposite which the cloak forms a peculiar aperture or little tube. The animal (*Callitriche*, Poli) has the edge of its cloak provided with branched tentacula near the rounded angle, as it is there that the water required for respiration enters. In front, near the acute angle, there is a small transverse muscle, and a large one behind near the obtuse angle. The foot resembles a tongue.

In *Mytilus*, Lam., the summits [of the valves] are nearly terminal. Some species are smooth, others striated. The common Mussel (*M. edulis*, Linn.) is spread in extraordinary abundance along all our coast, where it is often suspended, in long clusters, to rocks, piles, ships, &c. It forms an article of food of some importance, but it is dangerous when eaten to excess; [and under certain unknown circumstances, or to some individuals, becomes deleterious]. Some species have been found in a fossil state, (which Brongniart distinguishes generically by the name *Mitiloide*).

In *Modiolus*, Lam., the apices are lower, and towards the third of the hinge; they are also more protuberant and rounded, whence the shell has more of the ordinary shape of bivalves. We may also distinguish separately the *Lithodomus*, Cuv., which has an oblong shell, almost equally rounded at both ends, and the summits very near the anterior. They at first suspend themselves to stones, like the common Mussels, but then they perforate them, and bury themselves in the excavations, whence they cannot again issue. After they have made their cells, the byssus ceases to grow.* One species (*Mytilus lithophagus*, Linn.) is very common in the Mediterranean, where it furnishes a food agreeable enough on account of its peppery taste. There is another (*Modiola caudigera*) which has the posterior end of each valve armed with a very hard little appendage, that is, perhaps, of service in the excavation of its dwelling.†

THE FRESH-WATER MUSSELS (*Anodontes*, Brug.)—

Have the anterior angle rounded like the posterior; and the angle near the anus obtuse, and almost rectilinear: their thin and moderately ventricose shell has no tooth in the hinge, but merely a ligament occupying its entire length. The animal (*Limnæa*, Poli) is without a byssus; and it creeps over

* "We cannot imagine," says Sowerby, "that this remark has been made from actual observation, because we believe it to be contrary to the nature of the animal to be at one time attached by a byssus, and not at another; and, moreover, we have ourselves seen Lithodomi not more than one-eighth of an inch in length, in as completely-formed proportions as the fuller-grown specimens."—ED.

† The means by which the saxicavous bivalved Mollusca perforate rocks has given rise to much discussion: some believe that they do the work by the mechanical action of the valves; others attribute it to a solvent secreted by the animal. All things considered, I think the first of these opinions, notwithstanding the difficulties in the way of its adoption, is yet the most probable.

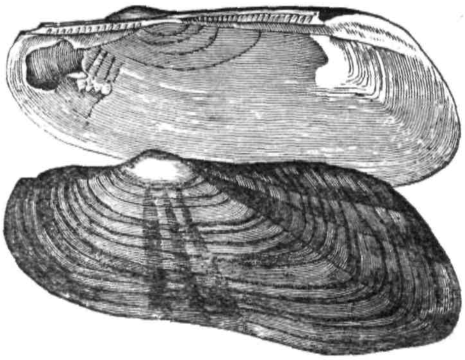

Fig. 190.—Anodon dipsas.

the sand or mud by means of a large, compressed, and nearly quadrangular foot. The posterior end of the cloak is garnished with many small tentacula. The Anodontes live in fresh waters.

We have some native species; and of the largest (*Mytilus cygneus*, Linn.) the valves are used to skim milk. From its insipidity, the animal is not edible.

M. de Lamarck distinguishes, under the name of *Iridina*, an oblong species, whose hinge is granulated its entire length. The cloak of the animal is closed a little behind.* The *Dipsas* of Leach is founded on another species, which has the angles more decidedly marked, and a vestige of a tooth in the hinge.

THE UNIONES (*Unio*, Brug.)—Resemble the Anodontes in the shell and in the animal, but the hinge is more complicated. There is a short cavity in the anterior part of the right valve, which receives a short plate or tooth from the left one, and behind it is a long plate, which is inserted between two others on the opposite side. They also inhabit fresh water, preferring running streams. Sometimes the anterior tooth is more or less large and unequal, as in the *Mya margaritifera*, Linn., whose pearls have been used in making ornaments. At other times this tooth is laminated, as in *Mya pictorum*, Linn., known to every body [from its shells being used in holding water colours].

(A great number of species, remarkable for their size and figure, are found in the lakes and rivers of North America. MM. Say and Barnes [and Lea] have described them, and have proposed some subgenera amongst them.)

M. Delamarck distinguishes the *Hyria*, with the angular productions of the hinge so decided that their shell is almost triangular. And the *Castalia*, the shell of which, somewhat heart-shaped, is striated with rays; and the teeth and plates of the hinge are grooved across their longest diameter, which gives them a relationship with the *Trigoniæ*.

There ought to be placed near the Uniones some marine shells, which have a similar animal, and very nearly the same sort of hinge, but the summits of the valves are more swollen, and prominent ribs radiate from them to the margins. These are the *Cardita*, Brug. Their shape is more or less oblong or cordate. In some the shell gapes on the lower side. The *Cypricardia*, Lam., are Carditæ with the tooth under the summit divided into two or three. Their form is oblong, and their sides unequal. M. de Blainville has again separated the *Coralliophaga*, whose shell is thin, and the lateral lamina [of the hinge] so much obliterated that it might induce us to approximate them to the Venus. One species is known, that burrows in masses of coral.

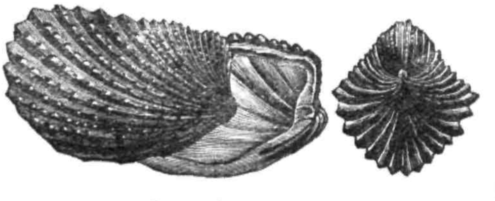

Fig. 191.—Cardita caliculata.

The *Venericardia*, Lam., differ from the Cardita only because the posterior lamina of their hinge is more transverse and shorter, thus making an advance to the Venus: their form is almost round. It may be inferred from the muscular impressions that their animal has also a resemblance to that of the Cardita and of the Unio. Both of them approach the Cardia in general form and in the direction of their ribs.

I suspect that this is also the place for the *Crassatella*, Lam. (*Paphia*, Roiss.), which has sometimes been approximated to Mactra, and at others to Venus. The hinge has two slightly-marked lateral teeth, and two very strong middle ones, behind which, extending to both sides, is a triangular cavity for an internal ligament. The valves become very thick with age, and the impression made by the margins of the cloak, leads to the belief that there are no extensile tubes.

THE THIRD FAMILY OF THE ACEPHALA TESTACEA,—

THE CAMACEA,—

Has the cloak closed, but perforated with three holes, through one of which the foot passes; the second furnishes an entrance and exit to the water required for respiration; and the third is the vent; the two latter are not prolonged into tubes, as in the following family.

The family comprises only the genus

CHAMA, Linn.,—

Where the hinge is very analogous to that of a Unio,—that is to say, the left valve near the summit is provided with a tooth, and further back with a salient plate, which are received into corresponding fossæ of the right valve. This genus has justly been subdivided. The *Tridacnæ*, Brug., have a shell greatly elongated transversely, and equivalve; the superior angle, which answers to the head and summit, very obtuse. The animal is very remarkable, for it is not placed in the shell like most others, but its organs are all directed, or as it were pressed out, forwards. There is a wide opening in the anterior side of the cloak for the passage of the byssus: a little beneath the anterior angle there is another aperture by which the water gets access to the branchiæ; and in the middle of the inferior side there is a third smaller opening, corresponding with the anus, so that there is no need of a passage in the posterior angle, which is solely occupied by a cavity of the cloak, open only to the third aperture, which has been just mentioned. There is but a single transverse muscle, corresponding to the middle of the margin of the valves.

In the *Tridacna* of Lamarck the shell has in front, like the cloak, a large aperture with denticulated margins for the [exit of the] byssus, which is distinctly tendinous, and continuous with the muscular fibres. Such is the *Chama gigas*, Linn., of the Indian Ocean, famous for its enormous size. There are individuals which weigh more than three hundred pounds. The tendinous byssus by which it is suspended to rocks is so large and tough as to require to be cut with an axe. The animal is edible, although very hard. [It is placed in the shell somewhat differently from other Lamellebranchiate Mollusca; for, from a peculiar inversion, it is found that its different parts have not their ordinary correspondency,—a circumstance which Blainville thinks is owing to the *suspended* condition of the shell.]

Hippopus, Lam.—The shell is closed and flattened in front, as if it had been truncated. [*H. maculatus*, from the South Seas, is the only species.]

Chama, Brug.—Shell irregular, inequivalved, often lamellated and spinous, and attached to rocks, corals, &c., in the manner of Oysters. The summits are often very protuberant, unequal, and curled. Often also their interior cavity has this form, though nothing on the exterior surface may indicate it. The animal (*Psilopus*, Poli) has a small foot, bent almost like that of a man. The tubes, if there are any, are short and separate, and the aperture through which the foot passes is little larger than them. There are some living species in the Mediterranean; and there are also several fossil species. [The *Cleidothærus*, Stutchbury, has a very exact resemblance to Chama, but is worthy generic distinction from the remarkable circumstance of its internal hinge cartilage having an elongated testaceous appendage, in form resembling the human clavicle. The only species is from Port Jackson.]

The *Dicerates*, Lam., do not appear to differ from Chama in anything essential; but their hinge tooth is very thick, and the spirals of their valves are so prominent as to prompt a comparison of their form with two horns. [Only known in a fossil state.]

Isocardia, Lam., has a free, regular, ventricose shell, the beaks of the valves distant, turned backwards, and involute. The animal (*Glossus*, Poli) differs from that of Chama only in having a larger and oval foot, and in the anterior aperture of the cloak beginning to assume the ordinary proportion. One species (*Chama cor*, Linn.) is found in the Mediterranean [and German Ocean].

THE FOURTH FAMILY OF THE ACEPHALA TESTACEA,—

THE CARDIACEA,—

Have the cloak open in front; and there are besides two separate apertures, (one for respiration and one for a vent,) which are prolonged in tubes, sometimes distinct, and at others united together. There is always an adductor muscle at each extremity, and a foot, which in general enables the animal to creep. We may regard it as a very general rule, that those which have long tubes live buried in the mud or sand. This peculiarity of their organization is to be traced on the shell by the greater or less depth of marks made by the insertion of the edges of the cloak previous to its uniting with the impression of the posterior transverse muscle.

THE COCKLES (*Cardium*, Linn.)—

Have, like most other Bivalves, a shell with equal ventricose valves, with prominent beaks curved towards the hinge, which gives them, when we view them laterally, the figure of a heart, whence their generic name. Ribs, more or less prominent, trend from the beaks to the margins of the valves. But that which distinguishes the Cardia is their hinge, where we may notice, on both sides in the middle, two little teeth; and at some distance before and behind, a tooth or prominent lamina. The animal (*Cerastes*, Poli) has usually an ample aperture in the cloak, a very large foot, bent in the middle, with its point directed forwards, and two short or but moderately long tubes.

The species of Cardia are numerous on our coasts, and the *C. edule*, Linn., is gathered for food. [Fossil species occur in nearly all the fossiliferous beds, from the mountain limestone upwards.]

We may separate from them, under the name of *Hemicardia*, the species with valves compressed from before backwards, and strongly keeled in the middle, for it is difficult to believe that the animal is not modified to suit this singular configuration.

THE DONACES (*Donax*, Linn.)—

Have nearly the same kind of hinge as the Cardia, but their shell is of a very different form, being a triangle, of which the obtuse angle is at the summit of the valves, and the base at their edge, and of which the shortest side is that of the ligament, or the posterior side, a rare circumstance among Bivalves. They are generally small shells, prettily striated from the beaks to the margins. Their animal (*Peronæa*, Poli) is furnished with long tubes, that are received into a sinus of the mantle.

We have some native examples. (The *Donax irregularis*, a fossil from the neighbourhood of Dax, is the type of the genus *Gratelupia* of Desmoulins, and is distinguished from the other Donaces by several tooth-like lamellæ which accompany the hinge teeth.)

THE CYCLADES, Brug.,—

Like the Cardia and Donaces, have two teeth in the middle of the hinge, and before and behind two prominent and sometimes crenulated laminæ; but the shell, as in several species of Venus, is more or less rounded, equilateral, and transversely striated. The external tint is usually grey or greenish. The animal has moderate tubes, and is an inhabitant of fresh waters.

One species (*Tellina cornea*, Linn.) is very common in our marshes.

Cyrena, Lam.—The shell is thick, somewhat triangular and oblique, and covered with an epidermis, and is further distinguished from the Cyclas by having three hinge teeth. They likewise inhabit rivers, but we have none in France. *Cyprina*, Lam.—Shell thick, oval, with curved beaks, three strong teeth, and besides, a lateral tooth behind: under the teeth a large fossa, in which is lodged a part of the ligament. *Palathœa*, Brug., [*Potamophila*, Sowerby,] has the shell a right-angled triangle; three teeth in one valve and two in the other, diverging from the beaks; and the lateral teeth approximated. The single species known [*Venus subviridis*, Gmel.] is from the fresh waters of India. [It is also found in the river Congo.]

This is the proper place to set another genus dismembered from the Venus, viz., the *Corbis*, Cuv. (*Fimbria*, Megerl.) Marine transversely oblong shells, which have also strong middle teeth and well marked lateral plates: their external surface is furnished with transverse ribs, so regularly crossed by rays that it may be compared to wicker-work. [*Venus fimbriata*, Linn., is the type.] Since the impression of the cloak has no fold, the tubes ought to be short. There are some fossil species.

THE TELLINIDÆ (*Tellina*, Lin.)—

Have in the centre [of the hinge] a tooth on the left and two teeth on the right, often bifid, and at some distance in front and behind; on the right valve, a lateral tooth or plate, which does not penetrate into a cavity of the opposite one. There is a slight fold near the posterior extremity of both valves, which renders them unequal in that part, where they gape a little.* The animal (*Peronæa*, Poli), like that of Donax, has two long tubes, respiratory and excrementitial, which can be withdrawn into the shell, and concealed in a duplicature of the cloak. The shells are generally transversely striated, and painted with beautiful colours. Some are oval and thickish; others oblong and much compressed; others lenticular. Instead of a fold, we often find in the latter merely a deviation in the course of the transverse striæ. We could separate generically some oblong species, which have no lateral teeth; and others that, with the hinge of a Tellina, have no posterior fold, form the genus *Tellinides*, Lam.

It is necessary to distinguish from Tellina the *Loripes*, Poli, which have a lenticular shell with the central teeth almost obsolete, and behind the nates a simple groove for the ligament. The animal has a short double tube, and its foot is prolonged into a cylindrical cord. We notice within the valves, besides the ordinary impressions, a mark going obliquely from the impression of the anterior muscle (which is very long) towards the nates. The impression of the cloak exhibits no sinus for the retractor muscle of the tube.

Lucina, Brug., has, like Cardium, Cyclas, &c., separate lateral teeth penetrating between corresponding laminæ of the other valve; and in the centre are two teeth, which are often scarcely visible. The shell is orbicular, without an impress of the retractor muscle of the tube, but that of the anterior retractor muscle is very long. Having thus the same marks as Loripes, their animals ought to be analogous. [It is obvious that Loripes and Lucina are but one and the same genus.] The recent species, so far as is known, are much less numerous than the fossil: the latter are very common in the vicinity of Paris.

We ought to place near the Lucina the *Ongulina*, which has an orbicular shell, two hinge teeth, but no lateral ones, and the anterior muscular impression is not so long.

* [" The irregular flexuosity of the anterior ventral margin appears to have been constantly regarded as the principal distinguishing character of this beautiful genus; and when we consider the number of species possessing this character, and agreeing also in other general circumstances, it may perhaps be still considered as the essential character of the genus."—*Sowerby*.]

THE VENUSIDÆ (*Venus*, Linn.)—

Comprise many shells, whose common character is to have the teeth and laminæ of the hinge collected under the beaks in a single group. They are in general flatter and more elongated in a direction parallel with the hinge than the Cardia. Their ribs, when there are any, are almost always transverse, which is the contrary of the rule in the Cardia. The ligament often leaves, behind the beaks, an elliptical impression, to which the term *vulva* has been applied; and in front of the beaks there is almost always another oval impression that has been called the *anus*.* The animal has always two tubes, capable of being more or less protruded beyond the shell, but they are sometimes united together apparently in one; and it has also a compressed foot wherewith to crawl.

M. de Lamarck restricts the name *Venus* to those which have three divergent teeth under the beaks. This character is peculiarly distinct in the species with an oblong, slightly convex shell. [These have been separated by Sowerby to form his genus *Pullastra*, to which he unites the *Venerupis*, Lam., believing that the latter do never perforate rocks, but merely occupy the holes excavated by other animals.] Some (*Astarte*, Sow., or *Crassina*, Lam.) have only two diverging hinge teeth, and resemble the Crassatella in their thickness and some other characters. Among the heart-shaped species it is important to notice those whose transverse ribs or striæ terminate in crests or tuberosities on the posterior side; and those which have longitudinal ribs and elevated crests. They lead by degrees to the *Cytherea*, Lam., which has a fourth tooth upon the right valve, projecting under the anus, and received in a corresponding fossa of the left valve. There are some species, as in Venus, of an elliptical and elongated form, and others that are ventricose, among which is the famous species (*Venus Dione*, Linn.), that originated the application of the name of the Goddess of Love to a shell, and remarkable for the long pointed spines that guard its posterior end. There are species too of an orbicular form with slightly curved beaks, in which the impression of the retractor muscle of the tubes forms a large, almost rectilinear triangle.

When the animals are better known, it is probable we may have to separate from Cytherea,—1. The species of a much compressed, lenticular shape, with beaks approximating to a point. There being no impression of the fold of the cloak, we infer that the tubes are not extensile. 2. Those of a ventricose, orbicular form, which want the impression just mentioned, but have a very long imprint of the anterior muscle, as in Lucina. 3. The thick species with radiated ribs and without the impression of the cloak, which connect the Venusidæ with the Venericardia.

There has been already separated from Venus the *Capsa*, Brug., which have on one side of the hinge two teeth, and on the other one only, but bifid; the shell has no anus, is considerably convex, oblong, and the impression left by the retractor muscle of the foot is considerable; and the *Petricola*, Lam., with two or three very distinct teeth, one of them forked, on each side of the hinge. Their form is more or less cordate; but, as they live in cavities of stone, [which they themselves perforate,] they become sometimes irregular. From the marks left on the shell by the cloak, their tubes ought to be larger.

The *Corbulæ*, Brug., similar in form to the triangular or heart-shaped Cythereæ, have only a single strong tooth in each valve, locking side by side. The ligament is internal. The tubes ought to be short; and the valves are rarely quite equal. The fossil species are much more numerous than those actually existing. Some live in the interior of stones. [The *Sphenia*, Turton, separated from Corbula, and which has *C. rostrata* as its type, has not been adopted by foreign Conchologists. Sowerby unites it to Mya.]

THE MACTRAIDÆ (*Mactra*, Linn.)—

Are distinguished among the shells of this family because the ligament is internal, and is lodged on both sides in a triangular fossa. They have all a compressed foot, fit to creep with.

In *Mactra*, Lam., the ligament is attended in the left valve, on both sides, with a lateral tooth, which locks within two laminæ of the opposite valve. Close to the ligament there is on both valves a tooth which is folded into the shape of the letter V, the point being nearest the umbo. The tubes are short and united. We have some species on our shores.† In the *Lavignons* [*Listera*, Turton] the lateral teeth are almost obliterated: nothing is noticeable but a small tooth near the internal ligament, and we may remark also a small exterior ligament: the posterior side of the shell is the shortest. The valves gape a little. The tubes are separate and very long, as in Tellina. One species (*Mya hispanica*, Chemn.) is native, living in the sand at the depth of several inches.

THE FIFTH FAMILY OF THE ACEPHALA TESTACEA—

THE INCLUSA,—

Has the cloak open at the anterior end, or near the middle only, for the passage of the foot. The opposite end is prolonged into a double tube, that can be pushed far beyond the shell. This is always

* These terms are apt to mislead, and are otherwise objectionable. The student should remember that the ligament is always on the posterior side of the oeaks.

† *Erycina*, Lam., is allied to Mactra, but indifferently characterized. One portion of them may be Crassatellæ. *Amphidesma*, Lam., or *Ligula* of Montagu, appear also to be affined to Mactra; but they are too little known to assign to them a definite place. [*Erycina* has been since well defined by Sowerby, who has characterized three species The same author has also given a good definition of *Amphidesma*, which is not synonymous with the *Ligula*; but our limits prevent us going into detail. *Cumingia*, Sowerby, should be placed near to Amphidesma. It is remarkable for the dissimilarity of the hinge of the two valves, one having a strong lateral tooth on each side of the ligament, and the other being entirely destitute of lateral teeth. The species are found in sand, in the fissures of rocks, and, so far as is known, they are tropical]

agape at both extremities. They live almost uniformly buried in sand or mud, in rocks or in wood.

THE MYADÆ (*Mya*, Linn.)—

Are bivalved shells with a variable hinge. The double tube forms a fleshy cylinder; the foot is compressed. From variations in the hinge MM. Daudin, Lamarck, &c., have established the following subdivisions, the first three having an internal ligament.

Lutraria, Lam.—The ligament, like that of the Mactra, is inserted in a large triangular fossa in each valve, and in front of that fossa is a small tooth en chevron, but there are no lateral teeth. The gape of the valves is wide, particularly at the posterior end, whence the large double tube for respiration and excremential matters protrudes. The foot, which issues at the opposite end, is small and compressed. The species burrow in sand at the mouth of rivers.

Mya, Lam., has in one valve a broad, spoon-shaped tooth, which projects into the other valve, in which there is a fossa, and the ligament is stretched from the fossa to the tooth. The species on our shores burrow in sand. Near to the Myæ we ought to place the *Anatinæ*, Lam., that have a small moveable testaceous appendage, connected with the ligament immediately before the hinder teeth. In the *Solemya*, Lam., the ligament appears externally, but a portion of it remains attached to a spoon-shaped tooth in each valve. There is no other tooth in the hinge. A thick epidermis overlaps the margins of the shell. An example (*Tellina togata*, Poli) lives in the Mediterranean. [The animal is so remarkable that it may become the type of a distinct family, for, instead of four lamellar branchiæ, it has two only, which are pectinate, or rather pennate.] *Glycymeris*, Lam. (*Crytodairia*, Daud.), has neither teeth, nor laminæ, nor fossæ, in the hinge, but a simple callosity, behind which there is an external ligament. The animal is similar to Mya. The best known species (*Mya siliqua*, Linn.), comes from the Arctic seas. *Panopea*, Mesnard, Lagr., have in front of the callosity of the preceding, a strong tooth immediately under the beak, which crosses with a similar tooth of the opposite valve,—a character which affines them to Solen. There is a large species from the hills at the foot of the Apennines, so well preserved that it has been sometimes believed to have been brought from the sea. Perhaps we ought to remove from the genus another fossil species, which is almost completely closed at the anterior end.

Fig. 192.—Anatina subrostrata

We may arrange at the end of these different modifications of the Myadæ, the *Pandora*, Brug., which has one valve much flatter than the other, an internal ligament placed crosswise, accompanied with a projecting tooth of the flat valve. The posterior side of the shell is elongated. The animal is more completely contained within the shell than it is in the preceding genera, and the valves close better, but its habits are the same. One native species (*Tellina inæquivalvis*, Chemn.), is well known.

Here, also, we group together some small but singular genera. The *Byssomia*, Cuv., characterized by an oblong toothless shell, with the opening for the foot very nearly in the centre of the valves, and opposite the beaks. They perforate rocks and corals. One species, furnished with a byssus (*Mytilus pholadis*, Mull.), is very numerous in the seas of the north. *Hiatella*, Daud., has a shell that gapes in the middle where the foot protrudes, as in the preceding, but the tooth of the hinge is more distinct. The shell is often armed backwards with [two] rows of spines. The species live in sand and amid zoophytes, &c. The northern seas possess a small species.*

THE SOLENES (*Solen*, Linn.)—

Have an oblong or elongated bivalved shell, but their hinge is always furnished with distinct teeth, and their ligament is always external.

Solen, Cuv., or *Razor-fish*, has a shell in the form of an elongated cylinder, with two or three teeth in each valve towards the anterior extremity, where the foot passes out. This is of a conical shape, and is used by the animal to form its burrow in the sand, in which it sinks rapidly on the approach of danger. Several species inhabit our shores. The species in which the teeth approach near the centre of the shell may be distinguished generically. The shell in some of them is still long and straight; in others it is wider and shorter, and the foot of these is very large. Some such are found in the Mediterranean. In the *Sanguinolaria*, Lam., the hinge is very nearly the same as in the broad Solenes, and there are two hinge teeth at the middle of each valve; but the valves approximate much closer at their ends, where they only gape to a slight extent, as in some of the Mactræ: *S. rosea* is the type. *Psammobia*, Lam., differs from Sanguinolaria in having a single tooth in one valve, which clasps in between two of the opposite ones. And the *Psammothea*, Lam., have only one tooth in each valve, but otherwise resemble Psammobia. [The *Glauconome*, Gray, is a genus of the family Solenaceæ, "inhabiting some of the great rivers of the continent of China." The shell is thin, oblong, with close margins, and three teeth in each valve. *Solenella*, Sowerby, is an interesting genus, partaking of the characters of Nucula and Solen, so that it may be regarded as the link that connects the two families Solenaceæ and Mactraceæ. "It belongs to the Solenaceæ, having the external ligament and the large sinus in the muscular impression of the mantle; but resembles Nucula in having the lateral teeth divided into a series of minute and pointed teeth, differing from it, however, in not having an internal ligament." The species are South American.]

THE PHOLADES (*Pholas*, Linn.),—

Have two principal valves, wide and ventricose on the side of the mouth, narrowed and elongated on the opposite side, and leaving at each end a large oblique opening; the hinge has, like that of the Mya,

* [Byssomia, Hiatella, Biopholius, and Pholeobius of Leach, are all reduced to the Saxicava of Lam., by Sowerby, and not unreasonably.]

properly so called, a lamina projecting from one valve into the other, and an internal ligament proceeding from that lamina to a corresponding fossa. The cloak is reflected outward upon the hinge, and contains one or sometimes two or three supernumerary pieces. The foot issues by the opening at the side of the mouth, which is the widest, and from the opposite end there comes out the two tubes united in one, and capable of being extended in every direction. The Pholades inhabit cells which they have made, some in the mud, others in rocks, [and others in wood]. They are sought after [in some countries] from their agreeable taste.

Pholas dactylus, Linn., occurs on our coasts. [The genus *Xylophaga* of Turton, which burrows in decayed wood, is reduced by Deshayes to Pholas.]

THE TEREDINES (*Teredo*, Linn.)—

Have the mantle extended in a tube much longer than the two small rhomboidal valves, and terminated by two short tubes, the base of which is furnished on each side with a calcareous and moveable kind of operculum or palette. These Acephales, while quite young, penetrate and establish their habitations in submerged pieces of wood, such as piles, ship's bottoms, &c., perforating and destroying them in every direction. It is thought that, in order to penetrate as fast as it increases in size, the Teredo excavates the wood by means of its valves ; but the tubes remain near the opening by which its entrance was effected, and through which, by the aid of its palette, it receives water and aliment. The gallery it inhabits is lined with a calcareous crust which exudes from its body, and which forms a second kind of tubular shell for it. It is a noxious and destructive animal in the seaports of Europe.

The common species (*T. navalis*, Linn.), which is said to have been introduced from the torrid zone, has more than once threatened Holland with ruin, by the destruction of its dikes. It is six inches in length and upwards, and has simple palattes. In tropical countries, there are large species with jointed and ciliated palettes, which deserve notice for the analogy they establish with the Cirrhopodes. Such is the *Teredo palmulatus*, Lam.

THE FISTULANA, Brug.—

Has been distinguished from Teredo, for its external tube is entirely closed at its larger end, and is more or less like a bottle or club. The species are sometimes found buried in wood or fruits that have been apparently submerged in the water; sometimes they are simply enveloped in the sand. The animal has two small valves and two palettes, as in the Teredo. Recent specimens are brought from the Indian Ocean, but our formations have preserved some fossil species.

Near Fistulana we should place *Gastrochæna*, Spengler*, whose shells have a toothless hinge, and the margins being wide apart in front, leave a large oblique opening, opposite to which there is in the cloak a small opening for the passage of the foot. The double tube, which can be concealed entirely within the shell, is capable of great elongation. It appears certain that they have a calcareous tube. In some species, the beaks are at the anterior angle; in others, near the middle. They live in the interior of madrepores, which they perforate. ["This bivalve is inclosed in the posterior clavate extremity of a shelly tube, which is attenuated and open anteriorly, its aperture being oblong and bilobate, or nearly divided into two by a sort of septum which does not quite meet in the centre: this double aperture serves for the passage of the two tubes of the animal : the posterior extremity of the shelly tube is closed. This irregular clavate tube, already inclosing the two valves of the Gastrochæna, is generally found within some other shell, to the inside of which it is attached, or it is protected in the ready-formed cavities of shells or rocks, or it lines cavities perforated by the animal itself in rocks, shells, or corals, and in this latter case, the double termination of the shelly tube projects beyond the surface of the coral or other object in which it is inclosed."]

Among fossils, two genera have been recognized furnished with tubes like the Teredo, but the first [*Teredina*, Lam.] has a little, spoon-shaped cavity in each valve, and a little loose piece, in form of a shield, at the hinge. The other (*Clavagella*, Lam.) has one of its valves agglutinated to the tube, and the other loose. A living species is found in the madrepores of the Sicilian seas, which has been described by M. Audouin. [The best description of this genus is given by Messrs. Broderip and Owen in the *Trans. of the Zoological Society*.]

Some naturalists think we should also place in this family

THE ASPERGILLUM,—

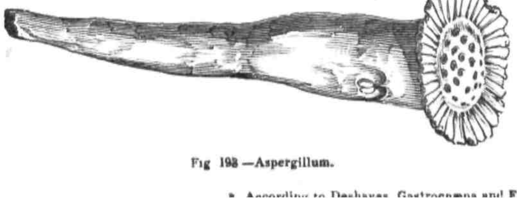

Fig 193 —Aspergillum.

The shell of which is formed of an elongated, conical tube, closed at its widest extremity by a disk perforated with numerous small tubular holes ; the little tubes of the outer range, being longest, form a kind of corolla round it. The reason for approximating them to the Acephala with tubes is found in the fact that there is a double

* According to Deshayes, Gastrochæna and Fistulana are the same.—Ed.

projection on one part of the cone, which really resembles the two valves of the Acephales. The resemblance between its little tubes, and those which envelope the tentacula of certain Terebella, formerly caused this animal to be referred to the Annelides.

The best known species (*Asp. javanus*) is seven or eight inches in length. [Rang conjectures that the animal of Aspergillum is essentially the same as that of Clavagella, and, as well as Blainville, he erroneously thinks that both are furnished with a byssus passing through all the anterior apertures of the tube, to attach it to foreign bodi The Aspergillum probably burrows in sand, the disk underneath, and the tubular part uppermost.]

THE SECOND ORDER OF THE ACEPHALES.

THE SHELL-LESS ACEPHALES, (OR A. NUDA). *

This is a small order, and differs so far from the other Acephales that it might be made a distinct class, were such a division considered to be convenient. Their branchiæ assume various forms, but are never divided into four leaflets: the shell is replaced by a cartilaginous tunic, sometimes so thin that it is as flexible as a membrane. We divide the order into two families.

THE FIRST FAMILY OF THE ACEPHALA NUDA,—

THE SEGREGATA,—

Embraces the genera whose individuals are isolated and without mutual organic connection, although they often live in societies.

THE BIPHORES, Brug. (*Thalia*, Brown ; *Salpa* and *Dagysa*, Gm.),—

Have the cloak and its cartilaginous envelope oval or cylindrical, and open at the two extremities. On the side of the anus the aperture is transverse, wide, and furnished with a valve, which allows the water to enter, but prevents its egress; on the side of the mouth the aperture is simply tubular. Muscular bands embrace the cloak and contract the body. The animal moves by forcing out from the anterior aperture the water which has entered the body by the posterior, so that its motion is always retrograde, whence it has happened that some naturalists have mistaken the posterior aperture for the real mouth. It also generally swims with the back undermost. The branchiæ form a single tube or riband, furnished with regular vessels, placed obliquely in the middle of the tubular cavity of the cloak in such a manner as to be constantly bathed by the water as it traverses that cavity.† The heart, the viscera, and the liver, are piled near the mouth towards the back; but the position of the ovary is variable. The cloak and its envelope exhibit in the sun the colours of the rainbow, and are so transparent that the whole structure of the animal can be seen through them : in many they are furnished with perforated tubercles. The animal has been seen to come out from its envelope without apparently any injury. But a more curious fact in their history is that, during a certain period, they remain united together, as they were in the ovary, and float in the sea in long chains, the individuals being disposed, however, in a pattern different in different species. M. de Chamisso assures us that he has ascertained a still more singular fact, which is, that the individuals that have issued from a multiplicate ovary have not an ovary of the same kind, but produce only isolated individuals of a form considerably different from their originals; and these again, give birth to others with ovaries similar to the parents of the first, so that there is, alternately, a scanty generation of separated individuals, and a numerous generation of aggregated individuals, and these two alternating generations do not resemble each other. Certainly we have observed, in some species, small individuals adherent to the interior of larger ones by a peculiar sucker, which were different in shape from those which contained them. These animals are found in abundance in the Mediterranean and the warmer portions of the ocean, and are frequently phosphorescent.

The *Thalia*, Brown, have a little crest or vertical fin near the posterior end of the back.

Amongst the *Salpæ*, properly so called, there are some which have, within the cloak, above the visceral mass, a gelatinous plate of a deep colour, which may be the rudiment of a shell. In others there is only a simple protuberance of the cloak itself in this situation, but of a thicker texture. In others there is neither plate nor pro-

* The *Acephalophora heterobranchiata* of Blainville The *Tunicata* Lamarck.

† Some authors say that this tube is perforated at both ends, and that the water traverses it, a fact I have in vain sought to determine

tuberance, but the cloak is prolonged into certain points. And of these some have a single point at each extremity, others have two, three, or even more at the oral extremity; some have one only at that end; and the greater number are simply oval or cylindrical.

THE ASCIDIÆ (*Ascidia*, Linn.), *Thetyon* of the Ancients.

The cloak and its cartilaginous envelope, which is frequently very thick, resemble sacs everywhere closed, except at two orifices, which correspond to the tubes of many Bivalves, one of which admits the water of respiration, and the other is the vent. Their branchiæ form a large sac, at the bottom of which the mouth is situated, and near the mouth is the mass of viscera. The envelope is much wider than the cloak properly so called. This is fibrous and vascular; and we perceive on it one of the ganglions between the two tubes. These animals attach themselves to rocks and other bodies, and are deprived of all power of locomotion; the chief sign of vitality which they exhibit consists in the absorption and evacuation of water through one of their orifices: when alarmed, they eject it to a considerable distance. They abound in every sea, and some of them are eaten.

Some species are remarkable for the long pedicle which supports them. M. Savigny, from his own researches and mine, has attempted to subdivide the Ascidiæ into several subgenera: such are *Cynthia*,—body sessile, envelope coriaceous, branchial sac plaited longitudinally. *Phallusia* differs from the preceding in the branchial sac not being plaited; their envelope is gelatinous. *Clavellina*,—the branchial sac without plaits, not reaching the bottom of the envelope, the body pedunculate, the envelope gelatinous. *Boltenia*,—the body pedunculate, and the envelope coriaceous. He also takes into consideration the number and form of the tentacula which encircle the inside of the branchial orifice, but their characters, in part anatomical, cannot yet be applied with certainty to a great number of species. Mr. Macleay has more recently proposed two genera, the *Cystingia* and *Dendrodoa*, on distinctions of the same nature.

THE SECOND FAMILY OF THE ACEPHALA NUDA,—

THE AGGREGATA,—

Comprises animals more or less analogous to the Ascidia, but united in a common mass, so that they seem to communicate organically with each other, and in this respect to connect the Mollusca with the Zoophytes; but what, independently of their peculiar organization, is opposed to this idea, is that, according to the observations of MM. Audouin and Milne Edwards, the individuals at their birth live and swim about separately, and only become united at a certain subsequent period of their life. Their branchiæ form, as in the Ascidia, a large sac, which the food must traverse before it can reach the mouth: their principal ganglion is likewise between the mouth and the anus, and the disposition of the viscera and of the ovary is very nearly similar.*

Nevertheless some have, like the Biphoræ, an opening at each end. Such are

THE BOTRYLLUS, Gœrtn.,—

That has an oval form, adherent to various foreign bodies, and united by tens or twelves, like the rays of a star. The branchial orifices are at the outer end of the rays, and the vents open in a common cavity, which is in the centre of a star. When an orifice is irritated one animal contracts only, but if the irritation is applied to the centre, they all contract. These minute creatures attach themselves to Ascidiæ, sea-weeds, &c. In some species three or four starred clusters appear to be piled upon one another.

THE PYROSOMÆ, Peron.—

Are united in great numbers, so as to form a large hollow cylinder, open at one end, and closed at the other, which swims in the ocean by the alternate contraction and dilatation of the individual animals which compose it. These terminate in points on the exterior, so that the whole surface of the cylinder is bristled with them: the branchial orifices are pierced near these points, and the vents open into the cavity of the tube. We might thus compare a Pyrosoma to a great number of the stars of a Botryllus that had been strung in a line together, but the whole mass remaining moveable.

The Mediterranean and Atlantic produce some large species, the animals of which are arranged with but little regularity. They sparkle during the night with all the brilliancy of phosphorus. A small species is also known (*P. atlanticum*), in which the animals are arranged in very regular rings.

The remaining species of this family have, like the typical Ascidia, the vent and the branchial aperture near each other, on the same extremity of the body. All that are known are fixed, and they have been hitherto confounded with the Alcyonia. The mass of the viscera of each individual is more or less prolonged in the cartila-

* To M. Savigny we are indebted for our knowledge of the singular organization of this family, which was formerly confounded with the Zoophytes. At the same time, MM Desmarest and Lesueur made known the peculiar structure of the Botryllus and of the Pyrosoma. See the admirable work of Savigny on Invertebrated Animals, part ii

ginous or gelatinous common mass, and more or less constricted and dilated at particular parts*; but each orifice always represents on the surface a little star with six rays. We unite them all under the name of *Polyclinum.* Some cover foreign bodies like fleshy crusts; others rise in conical or globose masses. Others again expand into a disk, so as to have a distant resemblance to a flower or an Actinia; or they are lengthened out into cylindrical branches, supported by more slender pedicles; or they are grouped into cylinders (*Synoicum*, Lam.). It even appears from some recent observations that the Escharidæ, hitherto arranged with polypiferous Zoophytes, belong to the Molluscans of this family.

THE FIFTH CLASS OF MOLLUSCA.

THE BRACHIOPODES.†

Like the Acephales, the Brachiopodes have a cloak with two lobes, and this cloak is always open. In place of a foot, they have two fleshy arms, garnished with numerous filaments, which they can push beyond the shell and withdraw within it: the mouth is between the insertions of the arms. We are not well acquainted with their organs of generation, nor with the nervous system.‡ They are all covered with a fixed bivalve shell, and are consequently destitute of locomotion. We only know three genera of them.

THE LINGULÆ, Brug.—

Have two equal, flattish, oblong valves, with the beaks at the end of one of the narrowest sides, gaping at the opposite end, and attached between the two beaks to a fleshy pedicle, by which they are suspended to rocks. Their arms are rolled up spirally, to lie within the shell. It appears that their branchiæ consist of little leaflets, arranged all round each lobe of the cloak, on its internal surface.

Only one species (*Lingula anatina*, Cuv.) is known, from the Indian Ocean. [Mr. Broderip has described two other species.]

THE TEREBRATULÆ, Brug.—

Have two unequal valves united by a hinge: the summit of one, more protuberant than the other, is perforated to permit the passage of a fleshy pedicle which attaches the shell to rocks, madrepores, other shells, &c. Internally, a small bony framework is observed, that is sometimes sufficiently complex, composed of two branches, which articulate with the imperforate valve, and which support the two arms, edged all round with long, closely-set fringes, between which there is, on the side next to the large valve, a third simply membranous and much longer appendage, usually spirally convoluted, and fringed like the arms. The mouth is a small vertical fissure between these three large appendages. The principal part of the body, situated near the hinge, contains the numerous muscles, which reach from one valve to the other, and between them are the viscera, which occupy but little space. The ovaria appear to be two ramose productions, adherent to the parietes of each valve. I have not yet been able to satisfy myself in regard to the position of the branchiæ. Numberless Terebratulæ are found, in a fossil or petrified state, in certain secondary strata of ancient formations. The living species are less numerous.

There are some species broader transversely, or longer in the direction perpendicular to the hinge, with a margin entire, or emarginate, or three-lobed, or with several lobes; there are even some that are triangular: their surface may be smooth, or furrowed, or veined: they are thick, or thin, or even transparent. In several, instead of a hole in the apex of their valve, there is an emargination, and this is sometimes partly formed by two accessory pieces, &c. It is probable that the animals, when better known, will present generic differences. Already there have been recognized in the

Spirifer, Sow., two large cones, formed of a spiral thread, which appear to have been the supports of the animal. In the *Thecidea*, Def., the support seems to have been incorporated with the small valve.

THE ORBICULÆ, Cuv.—

Have two unequal valves, one of which, being round and conical, resembles the shell of a Patella: the other is flat, and adherent to rocks. The arms of the animal (*Crispus*, Poli) are ciliated and spirally curved, like those of the Lingula.

* On these peculiarities Savigny has founded his genera *Polyclinum*, *Aplidium*, *Didemnum*, *Eucælium*, *Diazona*, *Sigillina*, &c., which it appears to us unnecessary to preserve.

† *Palliobranchiata* of M. de Blainville. [Rang makes them the 1st order of the Testaceous Acephales.]

‡ [Mr. Owen has an admirable memoir on their anatomy in the 1st vol. of the *Trans. of the Zoological Society*.]

§ Observations more precise than any we yet have made appear necessary before we can arrange the *Magas* of Sowerby, the *Strigocephales* of Defrance, and some other groups, near this one.

Our seas produce a small species (*Patella anomala*, Mull.).

The *Discinæ*, Lam., are Orbiculæ whose inferior valve is notched with a fissure.* We must also approximate to the Orbiculæ,

The *Crania*, Brug., whose animal has equally ciliated arms, but the shells have deep and round internal muscular impressions, in which some have fancied they saw a likeness to the figure of a skull. One (*Anomia craniolaris*, Linn.) is a native of our seas. There are many fossil species, of which M. Hœninghaus has given a beautiful monograph.

[The *Producta* of Sowerby is a fossil genus, with a shell somewhat like a Cardium in figure, and rendered remarkable by the manner in which the anterior margin is produced beyond the part inhabited by the animal. The species are, to a certain extent, characteristic of the strata of secondary formation, and particularly of the carboniferous or mountain limestone.]

THE SIXTH CLASS OF THE MOLLUSCA.

THE CIRRHOPODES† (LEPAS and TRITON, Linn.)

In several points of view the Cirrhopodes effect a sort of connection between this subkingdom and that of Articulated Animals. Enveloped in a cloak, and in a shell whose valves often resemble those of several of the Acephales, their mouth is furnished with lateral jaws, and the abdomen with filaments named cirri, arranged in pairs, composed of a number of little ciliated articulations, and representing a kind of feet or swimmers, such as we see under the tail of many Crustacea. The heart is situated in the dorsal region, and the branchiæ on the sides: the nervous system forms a series of ganglions in the abdomen. However, it may be said that the cirrhous feet are merely the analogues of the articulated appendages of certain Teredines, while the ganglions are in some respects only repetitions of the posterior ganglion of the Bivalves. The position of these animals in the shell is such that the mouth is at the bottom, and the cirri near the orifice. Between the two last cirri there is a long fleshy tube, which has been sometimes inadvertently mistaken for a proboscis; and at its base, near the back, is the vent. The stomach is puckered with a number of little cavities in its parietes, which appear to fulfil the functions of a liver: we notice besides a simple intestine, a double ovary, and a double serpentine canal terminating in the extremity of the fleshy tube previously mentioned. The eggs pass through this tube, and in their course are exposed to the influence of the seminal fluid. The Cirrhopodes are all fixed. Linnæus considered them all as belonging to one genus, which Bruguières divided into two, and these have recently been much subdivided.

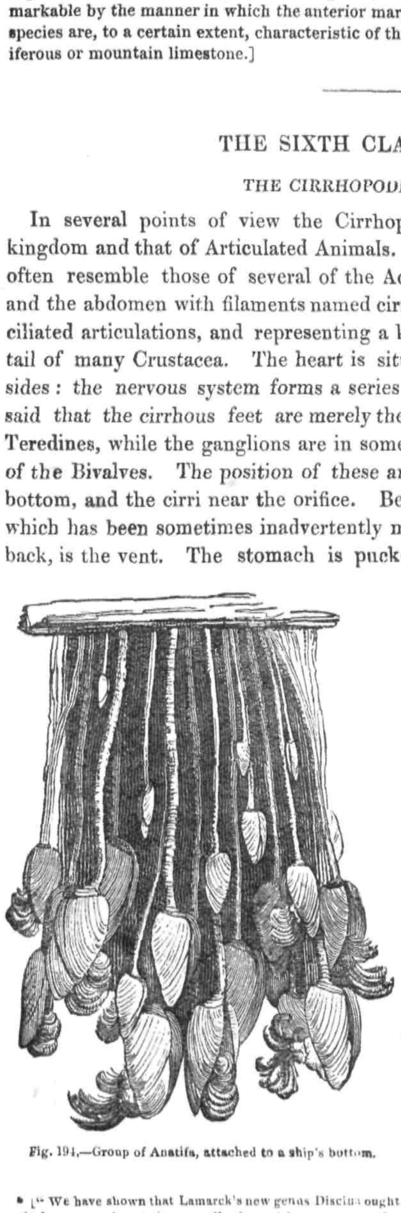

Fig. 194.—Group of Anatifa, attached to a ship's bottom.

THE ANATIFA, Brug.—

Has a compressed cloak, open on one side, and suspended to a fleshy tube, varying greatly as to the number of testaceous pieces with which it is furnished. The animal has twelve pairs of cirri, six on each side; those nearest the mouth are the shortest and thickest. The branchiæ are elongated pyramidical appendages, that adhere to the external base of the whole of the cirri, or of part of them.

In the commonest species (*Pentalasmis*, Leach) the two principal valves have a considerable resemblance to those of a Mussel; two others serve to complete a part of the margin of the shell opposite the beak; and a fifth odd one unites the

* ["We have shown that Lamarck's new genus Discina ought to be entirely expunged, as being actually formed from some specimens of *Orbicula norvegica*, which we sent to him."—*Sowerby*.]

† The *Cirripedes* of Lamarck; the *Nematopodes* of Blainville.

posterior margin to that of the opposite valve: these five pieces cover the whole of the cloak. From the place where the ligament should be springs the fleshy peduncle. A strong adductor muscle unites the two valves near their beaks. The mouth of the animal lies concealed behind them, and the posterior end of the body, with all its little articulated feet, comes out a little further down, between the first four valves. The widest spread species in our seas (*Lepas anatifera*, Linn.) has got its name from having given rise to a fable of its being the original or parent of the Barnacle-goose. They grow attached to rocks, piers, to the bottom of ships, &c. We may distinguish the *Pollicipes*, Leach, which, besides the five principal valves, has several small ones near the pedicle. In some species these valves almost equal the primary in size. There is often an odd one opposite the normal odd one. [*Scalpellum*, Leach, consists of thirteen valves, six on each side and one dorsal; and its peduncle is squamose.] *Cineras*, Leach.—The cartilaginous cloak incloses five valves, but of small size, so as not to occupy the whole surface. *Otion*, Leach.—The cloak contains only two very small valves, with three little pieces which scarcely merit that name; and there are two tubular appendages in the shape of ears. *Tetralismis*, Cuv., has only four paired valves encircling the aperture, two being longer than the others. The animal is partly contained in the pedicle, which is wide and hirsute. They are, in some degree, Balani without a tube. [*Lithotrya*, Sow., is pedunculated like Anatifa, but has, at the base of the peduncle, a shelly appendage analogous to the testaceous base of Balanus, and possesses besides a peculiarity not to be found in any other genus of this class, that of penetrating stones for its habitation.]

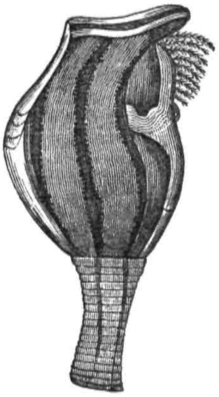

Fig. 195.—Cineras Cranchii.

THE BALANUS, Brug., OF ACORN-SHELLS.

The principal part of the shell consists of a testacous tube attached to various bodies, the aperture of which is more or less closed by two or four valves. This tube is formed of various pieces or compartments, which appear to unloose or separate in proportion as the growth of the animal requires additional room. The branchiæ, the mouth, the articulated tentacula, and the anal tube, differ little from the same parts in the Anatifa.

In *Balanus*, properly so called, the tubular portion of the shell is a truncated cone, formed of six outer valves, separated by as many inner ones, three of which are narrower than the others. Their base is usually formed of a calcareous lamina, fixed to various bodies. The four valves of the operculum close the aperture exactly. The rocks, shells, and piers of all our coasts are, in a manner, covered with a species, the *Lepas balanus*, Linn.

Fig. 196.—B. spinosus.

There have been separated from these the *Acasta*, Leach, whose base is irregular, convex outwardly, and not fixed: the greater number live within sponges. [Sowerby reunites Acasta to Balanus.] *Conia*, Blainv., whose shell has only four exterior valves. [On the contrary, in the *Octomeris*, Sow., the pieces or valves amount to eight.] *Asema*, Ranz., whose shell has no well-marked exterior valves. *Pyrgoma*, Sav., whose shell forms a very depressed cone, with only a very small aperture, almost as in a shell of the Fissurella. *Ochthosia*, Ranz., which have only three outer valves, and a bivalved operculum. *Creusia*, Leach, with four outer valves, and a bivalved operculum. M. de la Lamarck separates, under the name of *Coronula*, the depressed species in which the valves are loosely cellular; and under that of *Tubicinella*, the species which form an elongated cone, but narrowest at the base, and girded with rings that mark the successive epochs of its growth. There are species of both genera which plant themselves on the skin of Whales, and penetrate into their lard.

Fig. 197.—Conia radiata

Diadema, Ranz.—The shell is almost spherical, and has only two small valves, almost concealed in the membrane that closes their operculum. The opercula do not shut the aperture entirely without the aid of the membrane that unites them. They also live upon Whales; and we often find Otions attached to their surface.

SECOND DIVISION, FIRST CLASS.—MOLLUSCA.

THE general account of the organization of the Mollusca, given by Cuvier (pp. 335, 336,) does not require any important alteration or addition, save in one particular,—the structure of the *Shell*, which has recently been made the subject of careful microscopic investigation by Dr. Carpenter (Reports of the British Association, 1844 and 1847,) and Mr. Bowerbank, (Transactions of the Microscopical Society, Vol. I.)

In order that the structure of Shell and its relations to the tegumentary covering of other animals should be properly understood, it will be desirable to give a brief account of what is now known of the latter. The skin of Man, and of Vertebrata in general, is essentially composed of two parts, which are entirely distinct from each other in structure and offices, namely, the *corium*, *dermis*, *cutis-vera*, or true-skin; and the *epidermis*, *cuticle*, or scarf-skin. The true-skin is made up of fibrous tissue, interwoven with a texture made up of an assemblage of blood-vessels, nerves, and lymphatics, which are very copiously supplied to this part. The cuticle, on the other hand, is entirely destitute of vessels or nerves, and is thence said to be *extra-vascular*. But it is not on that account a mere inorganic glue exuded from the surface of the skin, as some have supposed. For it is made up of an assemblage of *cells*, resembling those of which the greater part of the fabric of plants is composed, and of which other parts of the animal body contain a large amount. These cells are most distinctly seen on the internal surface of the epidermis, that is to say, on the outer surface of the true skin; it is here that the growth and renovation of the epidermis are effected; new layers being continually formed to replace those which are worn off on the exterior. The cells of the outer surface of the epidermis are dried up by the evaporation of their contents, and are flattened into scales, which adhere to one another, so as to form a continuous membrane. This membrane in most animals is continually undergoing renewal; for as it is worn off from the exterior, it is replaced by the deeper layers, which then come to the surface and assume the characters of those which preceded them; whilst the layers last formed on the surface of the true skin are pushed outwards by the production of others still newer. What has been called the *rete mucosum*, which was supposed to be a distinct and peculiar layer, containing the colouring matter of the skin, and intervening between the true skin and the epidermis, is now known to be nothing else than the newest layer of the epidermis, through the whole thickness of which the colouring matter is diffused. The nails, hair, horns, scales, and teeth, all belong to the category of *epidermic appendages;* being originally generated by the growth of epidermic cells on the surface of the true skin, or within a little follicle or bag formed by a pit or depression of that surface. These cells, however, subsequently undergo various transformations, especially in the horny textures, by which their original character becomes obscured; but they may be well seen, in a nearly unchanged state, in the central portion of most feathers, and of many hairs.

Now the Shell of Mollusca is an *epidermic* structure, which is formed on the surface of their *mantle*, or thick spongy muscular skin, just as the *cuticle* of higher animals is formed upon the *cutis vera*. In its original state, it appears to consist of cells, similar to those of the ordinary epidermis: but these cells have the peculiar power of filling themselves as they grow, with carbonate of lime, which they draw in from the fluids of the mantle; and by coming into contact with each other, and adhering closely, they form the solid calcareous shell. In many shells, when the carbonate of lime has been removed by the action of dilute acid, a tenacious cellular membrane is left; the cells being held together by the interposition of horny matter, which gives considerable firmness to the texture. This is the case for example, in *Pinna* and its allies. In most other cases, however, the horny matter is exuded as a distinct layer on the surface of the calcareous shell; forming what has been termed (but incorrectly) the epidermis, the more appropriate term being the *periostracum*. This layer sometimes presents the appearance of cellular structure, but this is probably rather the impression of the layer o true shell beneath; it is not at all improbable, however, that it is produced by the agency of cells in the first instance, although no trace of structure is usually discernible in it.

In a large proportion of the Bivalve Shells of the class ACEPHALA, a distinct layer of cellular

structure may be detected on the surface; and this is frequently so thick as to make up a great part of the shell, as in *Pinna, Avicula,* and a large proportion of Cuvier's family *Ostraceæ.* The internal layer is usually more compact, and presents less distinct traces of cellular structure. In the shells of the Cuvierian families, *Camaceæ, Cardiaceæ,* and *Inclusa,* the greater part of the thickness is formed by the internal layer. In the *Mytilaceæ,* both layers are usually well seen, the inner layer, however, being usually the thicker. The successive additions to the shell are not made on the same plan in the two layers. The outer layer is merely extended by the junction of an additional portion to its margin; but the inner layer receives an addition to its whole internal surface, so that its thickness is increased, as well as its extent. This is well seen in the common *Oyster,* in which the successive layers of the shell remain unusually distinct. The white inner portion, of which the greater part of each valve is composed, is made up of a number of laminæ, each of which extends beyond the one external to it; and thus the outer laminæ are at the same time the oldest and smallest. Each of the layers of this substance is covered at its edge by an elastic yellowish-brown margin, which is so arranged that if the successive layers were closely adherent to each other, this substance would form a complete external covering to the shell. A section of the shell of an *Unio,* in which the layers do thus adhere, shows that the mode of growth of the two layers of a compact shell is essentially the same.

In many Bivalve shells of the class BRACHIOPODA, especially belonging to the genus *Terebratula* and its allies, a very curious arrangement exists; the shell being perforated by a number of minute apertures, extending from the internal to the external surface; and these canals being filled with prolongations of the soft tissue of the animal itself.

A number of curious varieties of shell-structure have been described by Dr. Carpenter (loc. cit.); who has also shown that, in many families and genera of bivalves, the structure of the shell affords characters of great importance in classification; and that it is possible in several instances to recognize the family, or even the genus, to which a specimen belonged, by the microscopic examination of but a very minute fragment of it.

In the Univalve shells formed by Mollusca of the class GASTEROPODA, the arrangement is generally different, especially in the *porcellanous* shells of many of the *Pectinibranchiata.* These are of great density, and contain very little animal matter. They have *three* layers instead of two, and these three layers are similar to each other in structure, being composed of a series of rhomboidal plates, disposed *vertically* to the surface of the shell, and giving an appearance of crystalline structure when the shell is broken across. The direction of these plates is the same in the inner and outer layers; but it is transverse in the middle layer, by which arrangement a greatly increased strength is gained. Each plate is made up of a set of long narrow cells filled with carbonate of lime, and adherent to each other at their edges. The shells of Gasteropoda do not, for the most part, undergo any thickening by successive additions; the enlargement required by the growth of the animal being effected by the extension of the margin, with no further addition to the previous internal layer than is sufficient to give it the requisite smoothness along the line of junction of the new and old portions.

In the *General Classification* of the Mollusca, given by Cuvier, the chief alteration required by the progress of knowledge is the entire removal of the CIRRHOPODA to the sub-kingdom ARTICULATA; their affinity to which, perceived by Cuvier, has been since placed beyond doubt by the discovery, that they issue from the egg in a condition resembling that of certain low forms of Crustacea, having eyes and active powers of locomotion, and only acquiring the form and condition of Cirrhopods after a series of metamorphoses, in which the eyes are lost, the locomotive organs altered in character, and the shell formed. This shell, in the *Balanus* and other sessile Cirrhopods, is composed of an outer and an inner plate, separated by a diploë or cancellated texture, which is sometimes of considerable thickness.

Perhaps the best primary division of the true Mollusca is into the *encephalous,* or those provided with a head, and the *acephalous,* or headless; in which last the mouth is not placed on a prominent portion of the body, but is concealed by the projection of the mantle.

The first division includes the three classes of CEPHALOPODA, PTEROPODA, and GASTEROPODA, from which last the HETEROPODA are detached by some Zoologists, to be ranked as a distinct class.

The second division may also be arranged into three classes, namely—the CONCHIFERA, forming the testaceous division of the Acephala of Cuvier; the BRACHIOPODA; and the TUNICATA, forming the naked or shell-less division of the Acephala of Cuvier. The first two of these classes both possess bivalve shells; but the structure of the animal is very different, the respiration being carried on in the

former by means of four branchial leaflets, whence they are distinguished as *Lamellibranchiata;* whilst in the latter the function is performed by means of the mantle itself, whence they are called *Palliobranchiata.* In many respects, the Conchifera are intermediate between the other two classes; being connected with the Brachiopoda through the genera *Placuna* and *Anomia*, and with the Tunicata through the order *Inclusa*. The Conchifera and Tunicata being thus raised to the rank of classes, their primary subdivisions will be *orders* instead of families.

CEPHALOPODA.

The researches of Professor Owen upon the structure of the animal of Nautilus, and upon its relations to the other Cephalopoda, have led him to propose a new arrangement of this class, which is now generally adopted. The entire class is divided into two orders; of which the first, including nearly all existing species of Cephalopods, approaches most nearly to vertebrated animals; whilst the second, which contains only one existing genus, but to which a great number of fossil forms are to be referred, is more closely allied to the Gasteropodous Mollusks. These orders are named according to the difference in the number of their gills, which is one of their best marked characters; but they differ also in many other particulars.

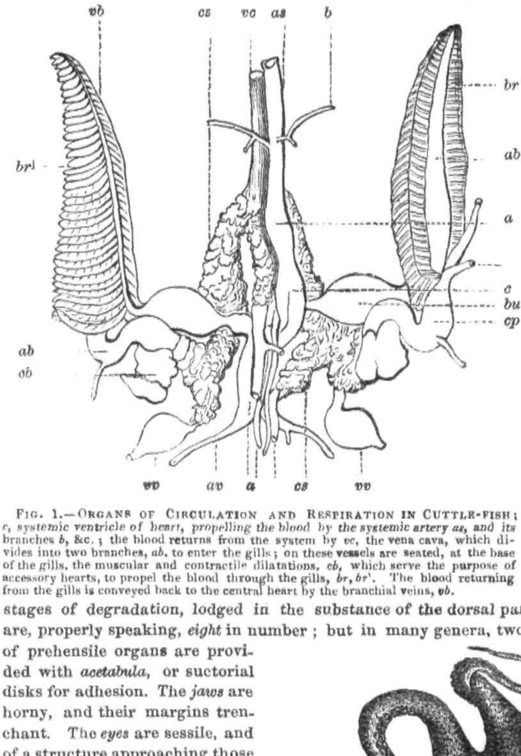

FIG. 1.—ORGANS OF CIRCULATION AND RESPIRATION IN CUTTLE-FISH; *c*, *systemic ventricle of heart, propelling the blood by the systemic artery as*, and its branches *b*, &c.; the blood returns from the system by *vc*, the vena cava, which divides into two branches, *ab*, to enter the gills; on these vessels are seated, at the base of the gills, the muscular and contractile dilatations, *cb*, which serve the purpose of accessory hearts, to propel the blood through the gills, *br*, *br'*. The blood returning from the gills is conveyed back to the central heart by the branchial veins, *vb*.

ORDER I.—DIBRANCHIATA. In this order, only one genus, *Argonauta*, has been hitherto found, in which the body is protected by an external shell; this consists of but one chamber, and does not adhere to the body of its occupant, either by a siphon or by muscular attachment. All the other genera of this order are naked; but they are provided either with an internal chambered and siphoniferous shell, as in *Spirula* and *Belemnosepia*, or the remains of a shell are found in various stages of degradation, lodged in the substance of the dorsal part of the mantle. The *arms* of the Dibranchiata are, properly speaking, *eight* in number; but in many genera, two longer tentacles are superadded. Both kinds of prehensile organs are provided with *acetabula*, or suctorial disks for adhesion. The *jaws* are horny, and their margins trenchant. The *eyes* are sessile, and of a structure approaching those of fishes in perfection. The organ of *hearing* is distinctly developed. The *gills* never exceed two in number (Fig. 1, *br*, *br*[1],); but the branchial circulation is aided by two muscular ventricles, situated one at the base of each gill (*cb*.); hence there are three distinct hearts in this order. There is an organ, the *ink-bag*, for secreting and expelling a black fluid, used as a means of concealment. The parietes of the *funnel* are entire.

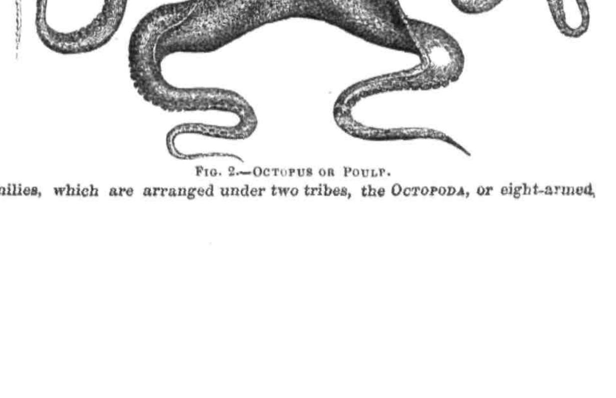

FIG. 2.—OCTOPUS OR POULP.

This order is divided by Professor Owen into the following families, which are arranged under two tribes, the OCTOPODA, or eight-armed,

and the DECAPODA, or ten-armed Cuttle-fish. The *Octopod* tribe consists of the two families *Testacea* and *Nuda;* to the former belongs the genus *Argonauta*, with (perhaps) the fossil genus *Bellerophon;* to the latter the genus *Octopus*, represented in the preceding figure (2) as creeping on the shore with its mouth downwards. The *Decapod* tribe, which includes the greater proportion of the existing Cephalopoda, is divided into four families;—the *Teuthidæ* or Calamaries, including the genera *Loligo*, *Sepioteuthis*, *Onychoteuthis*, *Sepiola*, *Cranchia*, and *Loligopsis* (Fig. 3); the *Sepiadæ*, or common Cuttle-fish, comprised under the single genus *Sepia;* the *Spirulidæ*, consisting of the single genus *Spirula*, which is a Decapodous Cephalopod, with an *internal* spiral chambered shell, furnished with a siphon; and the *Belemnitidæ*, a group known only by fossil remains, but determined from these to have been Decapodous Cephalopods, possessing conical chambered shells of which a description has been given in the text. From certain markings on the surface of these shells, and from the fact that distinct remains of an ink-bag have been frequently met with in the last or largest chamber of the cone, it has been argued that, notwithstanding the strong resemblance of the shell to that of many genera allied to the true Nautilus and belonging to the *Tetrabranchiate* group, the animal must have been *Dibranchiate*, and must have included the shell, together with its massive sheath, in the same manner as the Cuttle-fish includes the "pounce-bone." The Nautilus possesses *no* ink-bag, its power of completely withdrawing the body into its shell rendering such a means of protection unnecessary; and the ink-bag seems to be wanting in the several fossil genera, whose shells bear a strong resemblance to that of this genus.

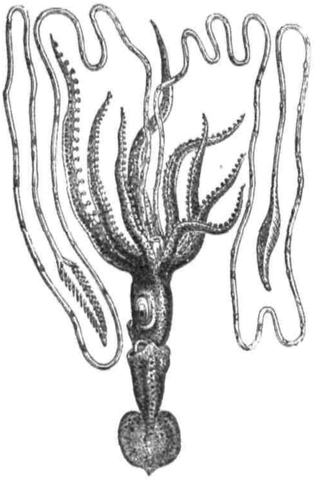

FIG. 3.—LOLIGOPSIS.

If, then, the ink-bag be peculiar to the Dibranchiate order, and its presence indicates the general organization of that order, the Belemnite must have belonged to an animal more or less closely allied to the *Sepia*. The justice of this view has been made evident by the recent discovery of specimens of Belemnite, in which the soft parts of the animal are so well preserved as to enable their form and general structure to be distinctly traced. From these it has been ascertained that the arms were furnished with hooks, as in the *Onychoteuthis;* and that the body had a pair of small lateral fins, situated at about the middle of its length. From the weight of its dense internal shell, the Belemnite may be supposed to have commonly maintained a vertical position; and, as its chambered portion was provided with a siphuncle analogous to that of *Nautilus*, the animal probably had the power of ascending and descending in the water with facility. It would rise swiftly and stealthily to fix its claws in the belly of a fish swimming at the surface above; and then, perhaps, as swiftly dart down and drag its prey to the bottom and devour it. We cannot doubt that, like the hooked Calamaries of the present seas, the ancient Belemnites were the most formidable and predaceous of their class. [See Professor Owen's Memoir on the Belemnite in the Philosophical Transactions for 1844.]

ORDER II.—TETRABRANCHIATA. The Cephalopodes of this order are provided with a large external univalve shell, symmetrical in form, straight, or convoluted on a vertical plane, and divided by a series of partitions into numerous chambers, of which the last-formed is the largest, and alone contains the body of the animal; a dilatable and contractile tube or *siphon* is continued from the posterior part of the animal through all the partitions and chambers of the shell; but the attachment of the shell to the body is effected by means of two strong lateral muscles, which are inserted into the walls of the last chamber. The arms are very numerous, short, and hollow, each containing a long, slender, retractile tentacle; they are destitute of suckers. The head is provided with a large flattened disk, which, besides acting as a defence to the orifice of the shell, serves also, in all probability, as an organ for creeping along the ground, like the foot in the Gasteropods. The *jaws* of the Tetrabranchiata are strengthened by a dense, exterior, calcareous coating, and have thick dentated margins. The *eyes* are pedunculated, and of a simple structure like those of the Gasteropoda. There is no organ of *hearing*. The *gills* are four in number, and without branchial hearts. The circulating system is provided with but one ventricle, which is systemic, or propels arterial blood. There is no ink-bag. The inferior parietes of the funnel are divided longitudinally.

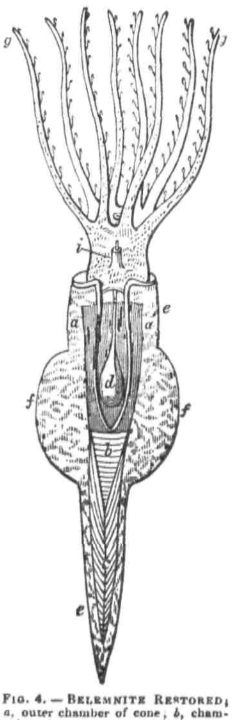

FIG. 4.—BELEMNITE RESTORED; *a*, *a*, outer chamber of cone; *b*, chambered portion; c. spathose guard; *d*, ink-bag; *e*, *e*, mantle; *f*, *f*, fins; *g*, *g*, hooked arms; *i*, funnel.

Of the TETRABRANCHIATE order, the only existing representative is the genus *Nautilus*, (Fig. 5,) whose general organization has been described in the previous account of the group. The

fossil remains of this order are very numerous, and are classed according to the structure of their chambered shells. Those which, like the *Nautilus*, have the septa smooth and simple, and the siphon either penetrating the centre of the chambers or running along the inner margin, are grouped into the family *Nautilidæ*, the principal genera of which are *Nautilus*, *Clymenia*, *Campulites*, *Lituites*, and *Orthoceratites*. Those, on the other hand, which have the septa sinuous and with lobated margins, and in which the siphuncle runs along their outer margin (in some instances, however, near their centre) are grouped into the family *Ammonitidæ*, of which the principal genera are *Ammonites*, *Baculites*, *Hamites*, *Scaphites*, and *Turrilites*.

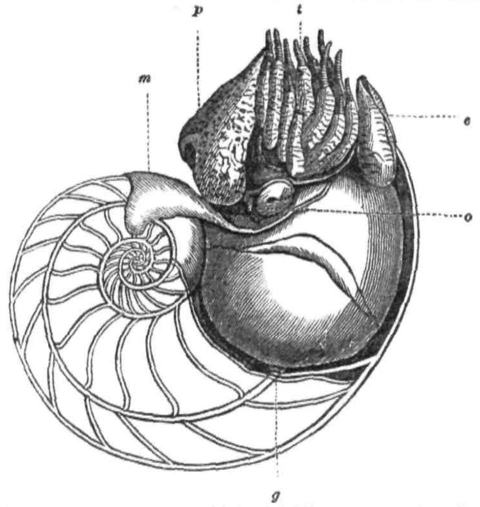

FIG. 5.—PEARLY NAUTILUS; with the shell laid open; *t*, tentacula; *e*, funnel; *p*, foot; *m*, portion of mantle; *o*, eye; *g*, siphon.

The following tabular arrangement will bring this classification at once under the eye.

I.—ORDER DIBRANCHIATA.

Tribe A.—OCTOPODA.

Family 1. *Testacea* Argonauta Bellerophon ?	Family 2. *Nuda*. Octopus

Tribe B.—DECAPODA.

Family 1. *Teuthidæ*, Calamaries Loligo Onychoteuthis Sepiola	Family 1. Cranchia Loligopsis Family 2. *Sepiadæ*, Cuttle-fishes Sepia	Family 3. *Spirulidæ* Spirula Family 4. *Belemnitidæ* Belemnites

II.—ORDER TETRABRANCHIATA.

Family 1. *Nautilidæ* Nautilus Clymenia Campulites	Family 1. Lituites Orthoceratites Family 2. *Ammonitidæ* Ammonites	Family 2. Baculites Hamites Scaphites Turrilites

It may be well to add, with reference to the family of *Camerines* (the *Foraminifera* of D'Orbigny) with which Cuvier's description of this class terminates, that it is now universally rejected from the Cephalopoda, though its true place in the animal scale cannot be determined until more shall be known of the animals by which the shells are formed.

No very important change has been made in the classification of the PTEROPODA, GASTEROPODA CONCHIFERA, and BRACHIOPODA. The principle advanced by Cuvier and Lamarck, however, that the classification of all Mollusca ought to be primarily based on the structure of the *animals*,—the characters of the *shell*, however useful for recognition, not being those on which a natural arrangement ought to be founded,—is now generally admitted; and the attention of Naturalists has been of late much directed to the increase of our acquaintance with the anatomy of the animals of the testaceous Mollusca. Many changes in the classification of Cuvier have been proposed, the grouping of the genera into orders being varied according to the principles of arrangement adopted by each systematist. But no one classification has met with such general acceptance, as to be entitled to replace that of Cuvier.

Much has been added, however, to our knowledge of the class TUNICATA, chiefly through the researches of Professor Milne Edwards. And it is now considered by many Naturalists (See the History of British Mollusca, by Forbes and Hanley, p. 1,) that this class should comprehend, not merely the animals included in the Cuvierian group of *Acephala nuda*, but also a large and important assemblage of compound animals hitherto ranked as Zoophytes, viz.—the *Bryozoa*. Referring to the Appendix to the Radiata for an account of the organization of these animals, which differ in some important particulars from the ordinary Tunicata, we shall at present confine ourselves to a review of the latter.

The ordinary Tunicata are divided by Professor Milne Edwards, who has made them an object of

special study, and who has added greatly to our knowledge of their organization, and especially of their development, into three orders, viz.—the SALPIDÆ, the ASCIDIADÆ, and the PYROSOMIDÆ.

I. The SALPIDÆ are, in some particulars of their organization, the highest of the Tunicata. They differ from the true Ascidians, as well in their habits as in their structure. They are not attached to solid bodies, but habitually swim in the waters of the ocean, sometimes singly, sometimes in clusters; their movement being due to the respiratory current presently to be described. In form they resemble short but rather wide tubes, with an opening at each end; the respiratory apparatus, instead of being formed by the entire dilated pharynx, here consists of two distinct branchial leaflets, and the branchial orifice is provided with a valve which permits the free entrance of water, but prevents its return. The viscera are collected into a single mass at the posterior extremity of the body; and this mass is very conspicuous, owing to the brilliant orange, brown, or reddish hue of the liver, of which a large part of it is composed, and to the transparency of the remainder of the body. As in the other Tunicata, a continual stream of water is drawn in through the branchial orifice by the vibration of the cilia with which the respiratory and digestive surfaces are clothed; and a current as constant is ejected from the anal orifice. These two orifices being opposite to each other in the *Salpæ*, and the animals being perfectly free, they acquire a progressive movement through the water, the branchial orifice being directed forwards. The *Salpæ* are met with in two states, *solitary* and *aggregated*. The latter are simply adherent to each other by little suckers, not being organically united like the compound and social Ascidians. The adhesion, however, is so strong in some species, that it is easier to tear the bodies of the animals than to separate them from each other; in other species, however, the adhesion is less powerful, so that when a mass is placed in a vessel of water, the sides of which are smartly struck, the individuals fall asunder. The curious observations of Chamisso, mentioned in the text (p. 382,) have been fully confirmed, especially by the researches of Krohn; who has further shown that there exists in these animals, as in the Ascidians, a double mode of propagation. He found that the *solitary* Salpæ produce chains of *aggregate* Salpæ by a kind of *internal gemmation* from a sort of *stolon* or creeping stem, resembling that of the social Ascidians, (Fig. 7,) but contained *within* their bodies, instead of extending on the outside. These aggregate Salpæ differ from the solitary individual from which they have sprung, in several points of their conformation, so that they have been described as distinct species. But from the several individuals of the chain of aggregate Salpæ, eggs are produced, each of which developes itself into original form of the solitary Salpæ. According to Krohn, every species of Salpa thus exists under two dissimilar forms; and on this fact, and others of a similar nature, the doctrine of an "alternation of generations" has been built up by Steenstrup and his followers. According to this doctrine, in those tribes in which such a series of phenomena is presented as that just described, we are to interpret them as follows.—Generation A (*e. g.* a *solitary* Salpa,) produces generation B, a being of a different form (*e. g.* an *aggregate* Salpa); and the offspring of generation B resemble generation A; so that each individual is unlike its own immediate parents and offspring, but resembles its grandparents and grandchildren. In this statement, however, the fact is too much lost sight of, that the two *modes* of reproduction alternate, as well as the two *forms* produced. The solitary Salpæ give origin to the aggregate forms, not by the sexual process and the development of ova, but by gemmation; so that the relation of the two is in reality the same, as that of the several individuals of the social and aggregate Ascidians (presently to be described) to the original founder of the colony; the only essential difference being, that in the case of the Salpæ, the individuals thus budded off become completely detached from their stock, and exhibit a difference of organization adapted to the difference of life which they are to lead. It is only when the sexual process intervenes, and ova are developed from which new stocks originate, that a new generation can be properly said to commence, unless we give to the term generation a much wider acceptation than it has hitherto possessed. We shall have to return to this subject, when considering the curious relations which subsist between certain *Polypes* and *Medusæ*, in the Appendix to the Radiata.

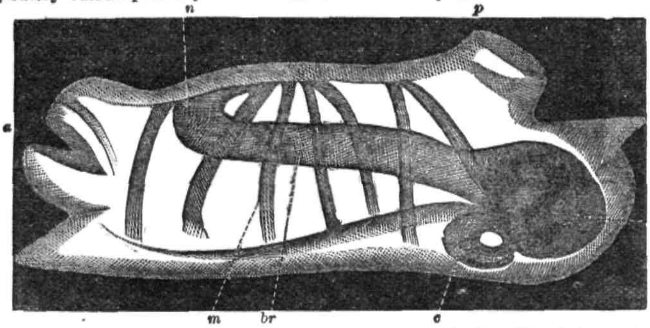

FIG 6.—BIPHORA, ONE OF THE SALPÆ; *a*, mouth; *p*, posterior or anal orifice; *f*, liver, inclosing other viscera; *c*, heart; *br*, branchial sac; *m*, muscular bands; *n*, nervous ganglion.

II. In the ASCIDIADÆ, the body is either fixed immediately to some solid mass, or is attached by a peduncle; the two orifices of the mantle are usually near each other (Fig. 8); the greater part of the internal cavity is occupied by the branchial sac, which may be regarded as a dilated pharynx; and the viscera occupy a comparatively small space at the bottom of this sac. (See Fig. 7.) This order may be divided into the three families of *simple*, *social*, and *compound* Ascidians.

1. The *Simple Ascidians* are completely detached from another; for, although frequently met with in groups or clusters, the individuals composing these have no organic union. They generally approach the oval form. They

have only one method of multiplication ; namely—by means of eggs. To this division belong the genera *Ascidia*, *Cynthia*, *Phallusia*, *Boltenia*, with some others.

2. The *Social Ascidians* adhere to solid bodies by a sort of root or creeping stem, which runs along their surface, and which puts forth *reproductive buds* that develope new individuals ; whence it results that these animals live in clusters or colonies, of which the several individuals are organically united. Each animal has its own heart, respiratory apparatus, and system of nutrition ; but a common circulation of blood extends through the stem and branches, connecting them all with each other. The relation between the separate animals thus bears a strong resemblance to that which subsists among the individual polypes of a *Sertularia* or other compound polypidom, in whose stem and branches a circulation of fluid takes place. To this family belong the genera *Clavellina* and *Porophora*.

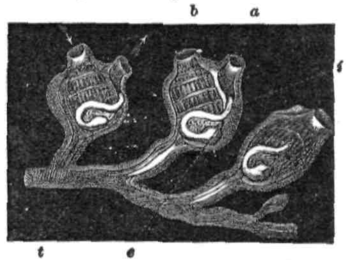

FIG. 7.—POROPHORA, a social Ascidian, *b*, branchial orifice, or mouth ; *a*, anal orifice ; *e*, stomach ; *i*, intestinal canal ; *t*, common stem.

3. The *Compound Ascidians* are united in a much more intimate manner, a great number of individuals (usually of very minute size) being grouped together in a single mass, and imbedded in a gelatinous or almost cartilaginous tissue, which has sometimes a very firm and even leathery integument, that serves as a mantle common to the entire cluster ; the covering of the individual animals being a very delicate membrane. On the surface of the mass are a number of small orifices, which have usually the form of six-rayed stars ; these are, some the oral or branchial, and others the anal openings, of the individuals imprisoned in the mass. Sometimes, however, the anal orifices of all the individuals are united into a common cloaca. The propagation of these singular beings, which possess a high organization, although looking like masses of inert jelly, takes place like that of the preceding family, in two distinct modes—namely, by *gemmation* or budding, and by the sexual production of *ova*. The reproductive buds are formed in the connecting tissue, and thus the number of individuals in a cluster is progressively increased. The eggs, on the other hand, give birth to individuals of an entirely new generation ; these in their young state have a form very different from that of the adults, and have an active power of locomotion, by which they are carried to a distance from the parent stock, to establish a new colony at a distance. Having become attached to some fixed body, they begin to undergo a series of metamorphoses, by which the Ascidian form is gradually evolved ; and from each single individual a cluster may ultimately be generated by the process of gemmation. In addition to the genera *Botryllus*, *Polyclinum*, and *Synoicum*, noticed by Cuvier, we have to mention *Aplidium* and *Sidnyum* cf Savigny ; *Leptoclinum*, *Amaroucium*, and *Botrylloides* of Milne Edwards ; and *Distoma* of Gaertner. It is to the exposition of the structure and relations of this most interesting group, that the admirable memoir of Professor Milne Edwards, in the Eighteenth Volume of the "Memoirs of the Institute of France," is especially devoted.

III. The PYROSOMIDÆ, as Cuvier has remarked (p. 383), are nearly allied to the *Botrylli* in the organization of the individual animals, but the individuals are united into tubes, each of which may be said to consist of a pile of the star-shaped clusters of the *Botryllus* ; and the entire tube is as free as are the bands of aggregate Salpæ, instead of being attached like the clusters of the Compound Ascidians. Like the Salpæ, the Pyrosoma tube acquires a progressive motion through the water from its respiratory current ; for whilst the branchial or oral orifices of the animals all lie on the outside of the tube, the anal orifices are all directed inwards, and open into the central channel, which is common to all. This central channel being closed at one end, the water is compelled to issue from the other ; and the continual stream in which it flows occasions a movement of the mass in the opposite direction.

THE attention which has been given of late to this tribe of animals, has caused a great increase of our knowledge as to their structure and actions ; and as the group is one of remarkable interest both to the Zoologist and to the Naturalist, a few particulars will be added to what has been already stated as to their structure, actions, and development. The attached species present us with a most remarkable contrast between the apparent inertness of their life, and the activity of the operations taking place within. If we keep some of the Compound Ascidians (which we may have found on a broad-leaved fucus cast ashore after a storm,) in a vessel of sea-water, "we find them lie there as apathetic as sponges, giving few signs of vitality beyond the slight pouting-out of tube-like membranes around apertures which become visible on their surfaces ; though a closer and microscopic examination will show us currents in active motion in the water around these apertures, streams ejected, and whirlpools rushing in ; indicating that however torpid the creature may externally appear, all the machinery of life, the respiratory wheels, and circulatory pumps, are hard at work in its inmost recesses." All these active operations belong, however, to the *vegetative* life, and do not indicate any consciousness or voluntary exertion on the part of these beings. The currents of water are produced, as already mentioned, by the agency of the cilia clothing the internal membranous surfaces ; and this action we have every reason to believe to be quite independent of the animal's will, and even beyond its control. It is a curious fact that *Salpæ* are sometimes found making their way through the water, after they have been deprived of their visceral mass by birds or fishes. The entire nervous system is here reduced to a single ganglionic centre (Fig. 8, *c*), which is situated between the two orifices, sends filaments to each of them, and also distributes its branches over the general surface of the mantle. No organs of special sensation are perceptible, and the only indication of common sensibility shown

by these animals, is the contraction of the mantle when the surface is touched, or when some irritating particle is drawn into the branchial orifice; by this contraction a jet of water is spurted out, sometimes to a considerable distance. No beings possessed of a complex internal structure, a distinct stomach and alimentary tube, a pulsating heart, and ramifying vascular apparatus, with branchial appendages for aerating the blood, and highly-developed secretory and reproductive organs, can be imagined to spend the period of their existence in a manner more completely vegetative than these.

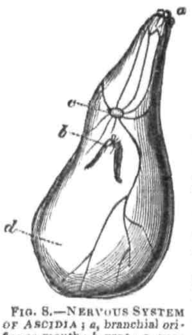

FIG. 8.—NERVOUS SYSTEM OF ASCIDIA; *a*, branchial orifice or mouth; *b*, vent; *c*, ganglion; *d*, mantle (the external coat being removed).

All the Tunicata above described appear to participate in a very remarkable peculiarity in the function of circulation. The heart is very simple in its structure, being merely a contractile dilatation of the principal trunk, without any distinct division into an *auricle* and *ventricle*, or a receiving and impelling cavity. This trunk first supplies blood, as in other Mollusca, to the mass of viscera, from which the fluid proceeds onwards to the respiratory surface, to be distributed over this for aeration; another portion, however, in some Ascidians, is sent direct to that surface. The whole fluid, after being thus exposed to the oxygenating influence of the streams of water continually passing over the branchial membrane, is collected by vessels which unite into a single trunk that conveys it back to the heart. This may be said to be the *direct* course of the circulation, because it is that which takes place in the Mollusca generally. But it is not constant in any of the Tunicata. After the heart has constituted its pulsations for a time, so as to propel the blood which it has received from the gills through the systemic trunk, its action becomes feebler, and the movement of the blood slower; a slight pause then occurs; and the pulsations then recommence, but *in the opposite direction*. The end of the heart which is connected with the systemic trunk now begins to contract first, and propels the blood towards the other extremity, into which opens the channel that previously brought it back from the gills; through this channel it now passes to the branchial surface; and thence it returns to the heart through the vessels which distribute it to the viscera. After continuing in this reversed direction for a time, the circulation again returns to its original course. The period of alternation varies considerably even in the same individual; from thirty seconds to two minutes intervening between every change. The average time of the flow in each direction is, however, the same. In the Social Ascidians, the circulating apparatus of all the individuals of a cluster is connected by trunks passing along the stem and branches (Fig. 7). The trunk that carries back the blood from the branchial surface does not at once proceed to the heart, but enters the footstalk, and joins the main trunk contained within the stem; and it is a branch proceeding from this trunk, and passing along the footstalk, that enters the heart. The alternation of the circulation takes place in these as in the solitary species; and it is curious that, if the flow of blood through the footstalk of any individual be prevented by a ligature, the circulation then takes place after the manner of the solitary species,—the blood being returned at once from the branchial surface to the heart, or being propelled directly from the heart to that surface.

The *metamorphosis* undergone by the simple and compound Ascidians is not one of the least curious parts of their history. They do not begin life as fixed animals; but as independent, free-moving, tadpole-like embryos. The larva, as it appears in the egg, is at first an oval disk; a sort of tail is then formed, by a prolongation of a portion of this disk, round which, however, it is at first wrapped; arm-like projections spring from the head, which may then be likened to a hydroid zoophyte; and in this condition it comes forth from the egg, and swims freely through the water by means of its rapidly-vibrating tail. It then becomes attached by its arms to rocks or sea-weeds; the tail disappears; that which was the head now becomes the base, sending out root-like projections by which it is firmly held; the visceral mass is gradually developed in the neighbourhood of this; the two orifices are formed at the opposite extremity; and the final form of an Ascidian begins to be manifested. The production of the cluster, in the compound species, by gemmation from the first individual, takes place subsequently to the full development of the latter; and the buds usually proceed from the root-like processes which it has sent forth.

One other remarkable fact concerning these curious animals deserves special mention. It has been lately discovered that the gelatinous mass in which the individuals of the compound Ascidians are imbedded, consists almost entirely of a substance *cellulose*, which has been usually regarded as peculiar to vegetables; being composed of oxygen, hydrogen, and carbon alone; and being identical with the material of which the greater part of their issues is composed. Even the tunics of the solitary Tunicata are found to contain a large proportion of the same material. The presence of this substance probably depends upon its abundance in the food of these animals, which appears to consist of particles of sea-weeds, and also of a number of vegetable bodies (formerly regarded as animalcules) of extreme minuteness, which float in the waters of the ocean and are drawn in by the ciliary current.

Although at first sight the peculiarities of these animals might seem to detach them from the other classes of the Molluscous sub-kingdom, yet the separation is not so wide as might appear. If the membranous, cartilaginous, or leathery integuments of an Ascidian were to be converted into a hard shell, symmetrically divided into two plates or valves, held together by a hinge on one side, and open at the other so as to expose the mantle, whilst the two orifices protruded at one extremity, it would present the closest similarity with many bivalve shell-fish. The similarity would be in many respects closer, were a *Salpa* to be thus transformed; since its branchial leaflets bear a near resemblance to the branchial lamellæ of the Conchifera. On the other hand, the gemmiparous production, which is so remarkable a feature of this class, connects it with Zoophytes; as does also the peculiarity of its circulation.

THIRD GREAT DIVISION OF THE ANIMAL KINGDOM.

THE ARTICULATED ANIMALS.

This third general type of organization is quite as strongly characterized as that of the *Vertebrata*. The skeleton is not internal, as in the latter: but is seldom altogether absent, as in the Mollusks. The articulated rings which encircle the body, and frequently the limbs, supply the place of skeleton—and being, in almost every instance, tolerably hard, furnish the necessary resisting fulcra to the muscles of locomotion; whence, as among the Vertebrates, we find that the several actions of stepping, running, leaping, swimming, and flying, are performed by them. There are also some families among them that are either footless, or have merely soft and membranous articulated limbs, by which they can at most crawl. This external position of their hard parts, with the muscles inward, reduces each articulation to the condition of a case, and only permits of two kinds of movements. When attached to the next articulation by a closed joint, as in the instance of the limbs, the only motion is by ginglymus, that is, in a single direction, so that numerous articulations are required to impart variety of action: and from this results a very great loss of power in the muscles, and consequently a general feebleness in the creature in proportion to its magnitude. The articulated pieces which compose the body frame-work, however, are not always thus connected; being oftener united by flexible membranes only, which slide considerably one over another, and so allow of more varied movements, but not of the same force.

The system of organs in which all Articulated Animals bear the nearest resemblance to each other, is that of the nerves.

Their brain, placed over the œsophagus, and supplying nerves to the parts adjacent to the head, is very small. Two chords, which encircle the œsophagus, are continued along the abdomen, and are connected at intervals by double knots or ganglia, from which the nerves of the body and of the limbs are sent forth. Each of these ganglia seems to perform the functions of a brain to the adjoining parts, and continues for a certain time to confer sensibility on them, after the animal has been divided. If to this be added, that the jaws of these animals, whenever they have any, are invariably lateral, and open and shut outward and inward, and not upwards and downwards, and that in none of them has a distinct organ of smell yet been discovered, nearly all has been expressed which it seems can be stated of them generally: for the existence of organs of hearing; the presence, number, and form of those of sight; the productiveness and mode of generation*; their kind of respiration; the ex-

* A remarkable discovery connected with this subject is that of M Herold, who found that in the egg of Crustaceans and Arachnides, the yolk communicates with the back through the interior.—See his Dissertation on the Eggs of Spiders, Marbourg, 1824; and that of M. Rathke on the Eggs of Crabs, Leipsic, 1829.

istence of organs of circulation, and even the colour of the blood, offer very great varieties, which must be studied under the various subdivisions.

DISTRIBUTION OF ARTICULATED ANIMALS INTO FOUR CLASSES.

The members of this great division, which have mutual relations as varied as they are numerous, still present themselves under four principal forms, whether we regard them externally or internally.

The ANNELIDES, Lamarck, or *Red-blooded Worms*, constitute the first. In these, the blood is generally of a red colour, like that of the Vertebrates, and circulates in a double and close system of arteries and veins, which have sometimes one or several hearts or fleshy ventricles, tolerably well marked: they respire by organs, which are either developed externally, or are spread over the surface of the skin, or concealed internally. The body, which is more or less elongated, is always divided into numerous rings, of which the first, which is termed the *head*, scarcely differs from the rest, except by the presence of the mouth and of the principal organs of sense. Several have their branchiæ uniformly spread over the surface of the body throughout its whole length, or only about the middle; others, and such as inhabit tubes, generally have them only at the anterior portion. None have any articulated limbs; but the greater number are furnished with silky feet, or bundles of stiff and mobile filaments, instead of them. They are generally hermaphrodite, and some require a reciprocal fecundation. The organs of the mouth consist either of jaws more or less powerful, or of a simple tube: their external sensitive organs are fleshy tentacles, which in some are articulated; and upon which are certain blackish points, that have been considered as eyes, but which are not present in all the species.

The CRUSTACEANS constitute the second form, or class, of Articulated Animals. These have articulated limbs, more or less complicated, attached to the sides of the body. Their blood is white, and circulates by means of a fleshy ventricle placed towards the back, which receives it from the gills, situate at the sides of the body, or at its hinder portion, and to which it returns by a ventral canal that is sometimes double. In the species last alluded to, the heart or dorsal ventricle is lengthened into a canal. These animals are all furnished with antennæ or articulated filaments, attached to the fore-part of the head, and which are generally four in number; besides which, they have several transverse jaws, and two compound eyes. It is among these only [throughout the Articulata] that we find a distinct auditory apparatus.

The third class of Articulated Animals is that of the ARACHNIDES, which, in common with a great number of Crustaceans, have the head and thorax joined into a single piece, with articulated limbs on each side, but the principal viscera of which are contained in the abdomen, which is attached to the hinder portion of the thorax. Their mouth is armed with jaws, and they have a variable number of simple eyes in the head; but never any antennæ. Their circulation is performed by a dorsal vessel, which gives out arterial ramifications, and receives venous ones; but the manner of respiration varies, some having true pulmonary organs with orifices leading to them at the sides of the abdomen, and others receiving air by means of tracheæ, in the same manner as Insects. All, however, have lateral apertures for this purpose, or true stigmata.

INSECTS constitute the fourth class of Articulated Animals, and the most numerous

in species of any throughout the Animal Kingdom. With the exception of some genera (the *Myriapoda*), which have the body divided into a great number of subequal articulations, they all consist of three parts : the head, upon which are the antennæ, the eyes, and the mouth ; the thorax or corselet, which bears the feet, and the wings whenever these exist ; and the abdomen, which is suspended to the thorax, and contains the principal viscera. Insects that have wings do not possess these [externally] before a certain age, and often pass through two forms or stages, more or less different, before they assume the winged state. They respire in all these states by means of tracheæ, which are elastic vessels that receive the air by orifices termed stigmata, pierced in their sides, and which are distributed by minute ramifications over every part of the body. The only vestige of a heart consists of a vessel which runs along the back, and alternately contracts along its course, but to which no branches have been discovered : hence it is believed that the nutrition of the several parts is effected by imbibition ; and it is probably this mode of deriving the nutriment which necessitates the kind of respiration proper to these animals, the nourishing fluid not being contained in vessels*, wherefore, as there was no means of directing it towards circumscribed pulmonary tubes to be aërated, the latter are consequently diffused over the whole body, instead. Thus it is, also, that Insects have no secretory glands, but merely long spongy vessels, which appear, over their whole surface, to absorb the several juices that should produce them, from out of the mass of nutritive fluid.†

Insects vary endlessly in the form of their manducatory and digestive organs, as also in the industry of their habits, and mode of life. Their sexes are always separate.

The Crustaceans and Arachnides were long confounded with them under a common name ; and in many respects bear a considerable resemblance to them, in external form, the disposition of their organs of movement, their sensations, and even manducation.

THE FIRST CLASS OF ARTICULATED ANIMALS,—

THE ANNELIDES,—

Are the only Invertebrate Animals that have red blood : this circulates in a double system of complex vessels. Their nervous system consists of a double nervous chord, the same as in Insects. Their body is soft, more or less lengthened, and often divided into a very considerable number of segments, or at least of transverse folds.

Almost all of them (the Earth-worms excepted) live in water. Many bury themselves in holes at the bottom, or construct for themselves tubes of mud and other matters, or even transude a calcareous substance, which forms a sort of tubular shell.

DIVISION OF THE ANNELIDES INTO THREE ORDERS.

This class, not a very numerous one, offers in its respiratory organs the basis of three sufficient divisions.

Some have their branchiæ in form of tufts or *arbuscules*, attached to the head, or

* M. Carus has observed various movements in the fluid which fills the body of the larvæ of certain Insects ; but these movements do not take place in a system of closed vessels, as in the higher animals.—See his Treatise, intitled *Discovery of a simple Circulation of Blood, &c.*, in German. Leipsic, 1827, 4to.

† See, upon this subject, my *Memoir on the Nutrition of Insects*, printed in 1799, among those of the Natural History Society of Paris Baudouin, An VII. 4to, p. 32.

to the anterior portion of the body. Nearly all of them inhabit tubes, and we term them *Tubicolæ*.

Others have upon the middle portion of their body, or all along their sides, branchiæ in form of arbuscules, crests, laminæ, or tubercles, in which vessels ramify. The greater number live in mud, or swim freely in the water; only a very few inhabiting tubes. These we denominate *Dorsibranchiata*.

Finally, others have no apparent branchiæ, and respire either over the surface of the skin, or, as is believed in some cases, by their internal cavities. The greater number live freely in water, or in mud; some, however, in humid earth: and we designate these *Abranchiata*.

The genera of the two first orders have all silky bristles, of a metallic colour, upon the sides, either simple or in bundles, and which supply the place of feet; but in the third order, there are some genera devoid of all such support.*

The particular study which M. Savigny has made of these feet or locomotive organs, has led him to distinguish, firstly, the foot or tubercle which bears the bristles, of which there is either one only upon each ring, or two, one above the other, which he respectively terms a simple or double oar; secondly, the bristles which compose a bundle upon each oar, varying much in consistence, and which either constitute true spines, or fine and flexible filaments, that are often dentelated, barbed, or irregularly so, &c.; and thirdly, the cirrhi, or fleshy filaments, adhering either to the inside or outside of the feet.

With respect to their organs of sense, the two first orders of Annelides have generally tentacles to the head, or filaments, which, notwithstanding their fleshy consistence, some moderns have designated antennæ; and several genera of the second and third orders have black and shining points, which have been regarded as eyes. The organization of the mouth varies exceedingly.

[The Annelides constitute one of the many small, but singular and highly interesting, tribes of animals, which, from being upon the confines of the peculiar class or subkingdom to which they in effect belong, exhibit, in a remarkable degree, the modifications of other higher groups: thus, by an ordinary observer, these creatures would be at once classed as Worms; and the common Earth-worm, one of them, would be regarded as the type of the grand class of Linnæan Vermes, the great majority of which, however, do not even belong to this great subkingdom, but to that of the Zoophytes, from which these articulated animals are at once distinguished by the possession of red blood circulating in a well-defined system, and a far more perfect developement of the nervous system; still, in their vermiform appearance, and in the elongated filaments with which many of them are furnished, they resemble certain Zoophytes,—on the other hand, they approximate to the most imperfect Fishes, such as the Lampreys and others, in which the spine has disappeared. Their annulose character, and nervous system, however, bring them nearer to the true Annulosa, especially the Myriapoda; this will at once be evident by comparing the figures of *Geophilus longicornis*, given in p. 486, with that of *Syllis monilaris* here figured.† Mr. Mac Leay accordingly con-

* M. Savigny has proposed a division of the Annelides according to their possessing locomotive silky bristles, or not so; reducing the latter to the Leeches. M. de Blainville, who has adopted this idea, ranges the bristled Annelides as a class, termed *Entomozoaires Chetopodes*, and the others as one designated *Entomozoaires Apodes*; but he mingles with the *Apodes* many intestinal Worms, which M Savigny does not admit.

† Mr. Mac Leay considers that they form the immediate connexion between such Vertebrata as Amphioxus and Myxine, and such Annulosa as Porocephalus, and other white-blooded Vermes, which have the sexes distinct (*Ann. Nat. Hist.*, Feb. 1840.)

siders them as the intermediate link between the Vertebrata and Annulosa, observing upon the curious circumstance that these two subkingdoms, so highly organized in the scale of the creation, should be linked together by a group exhibiting such great imperfections of structure.

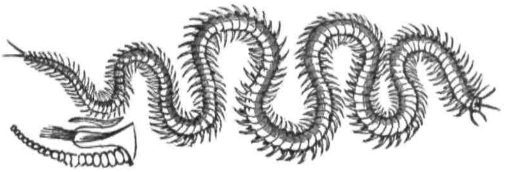

Fig. 198.—Syllis monilaris, with one of its locomotive organs and setigerous appendage attached thereto.

This class has been greatly neglected in this country. Dr. Johnston has, however, described various species (especially in the *Annals of Natural History*, for February, 1840), and Mr. Mac Leay, in the same number,* has noticed several fossil species. It is, however, in France that the greatest attention has been paid to them, especially by Savigny, Audouin, and Milne Edwards.]

THE FIRST ORDER OF ANNELIDES.

THE TUBICOLÆ.

Some species of this division form a homogeneous, calcareous tube, which probably results from their transudation, like the shells of the Mollusks, but to which the muscles do not adhere; others construct tubes, by agglutinating grains of sand, fragments of shells, and particles of mud, which they join by means of a membrane, which likewise is doubtless transuded; lastly, there are some, the tubes of which are entirely membranous, or horny.

To the first group belong

SERPULA, Linn.,—

The calcareous tubes of which invest, from their twisting about, fragments of stones, shells, and all sorts of submarine matters. The truncation of these tubes is either round or angular, according to the species.

The animal within has its body composed of a great number of segments; its fore-part widened into a disk, furnished on each side with many bundles of stiff bristles; and on either side of its mouth is a tuft of fan-like gills, in general vividly coloured. At the base of each tuft is a fleshy filament; and one of these, on the right or left side indifferently, is always prolonged and dilated at its extremity into a variously-formed disk, which serves for an operculum and mouth at the entrance of the tube when the creature retires into it.

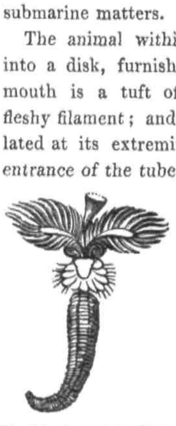

Fig. 199.—S. contortuplicata, taken out of its tube

The common species (*S. contortuplicata*, Ellis), has a round and twisted tube three lines in diameter. Its operculum is funnel-shaped, and its gills often of a fine red, or varied with yellow, violet, &c. This animal quickly fabricates its tube of mud, agglutinating into it whatever small objects lie around.

There is another and smaller species on our coasts, with a club-shaped operculum, armed with two or three little points (*S. vermicularis*, Gmelin). Its gills are sometimes blue. Nothing is more beautiful to see than a group of these Serpulæ when their wings are expanded.

In other species, the operculum is flat, and bristled with more numerous points. These are the *Galeolaria*, Lamarck.

There is one in the Antilles (*S. gigantea*, Pallas), which is found among the Madrepores, and the tube of which is often inclosed in their mass. Its gills roll up spirally when they are withdrawn, and the operculum is armed with two little branching horns

* Mr. Mac Leay has given the following quinarian distribution of the class in the memoir noticed above.

ANNELIDA

NORMAL GROUP *Polypoda* Marine animals, having their body provided with distinct feet.	Nereidina	Animals free, having a distinct head, provided with eyes, or antennæ, or both.
	Serpulina	Animals sedentary, and having no head, provided with eyes or antennæ.
ABERRANT GROUP. *Apoda.* Body without feet, or a distinct head.	Lumbricina	Animals without eyes or antennæ; body externally setigerous for locomotion; articulation distinct.
	Nemertina	Animals aquatic, without eyes or antennæ; body not externally setigerous; articulation indistinct.
	Hirudina	Animals provided generally with eyes, but not with antennæ; body not externally setigerous; articulation distinct.

like the antlers of a stag. This is the *Terebella bicornes*, Abeldg., and the *Actinia* or *Animal-flower* of Home. M. Savigny has made of it his subdivision of *Serpules cymospires*, which M. Blainville elevates to the rank of a genus.

M. Lamarck distinguishes the *Spirorbis*, the branchial filaments of which are much less numerous (three or four only on each side); their tube is of a tolerably regular spiral form, and they are mostly very small: such is *S. spirellum*, Pallas, and *S. spirorbis*, Muller.

SABELLA, Cuv. (*Amphitrite*, Lam.)

The same body and fan-like gills as in *Serpula*, but with the fleshy filaments adhering to the branchiæ, pointed, and neither of them forming an operculum; they are also not always present. Their tube appears oftener composed of granules of clay or very fine mud, and is rarely calcareous. The known species are rather large, and their branchial tufts are of an admirable delicacy and beauty.

Some, like the *Serpulæ*, have on the anterior portion of the back a membranous disk, across which pass the first pairs of their bundles of bristles; their branchial pectinations are turned spirally, and their tentacles reduced to slight folds. They are the *Serpules spiramelles* of M. Savigny, and the *Spiramilla*, Blainville. A large and beautiful species inhabits the Mediterranean, with a calcareous tube like that of the *Serpulæ*, or orange-coloured gills, &c., the *S. protula*, Nobis, or *Pastula Rudolphii*, Risso.

Others have no membranous disk on the foreparts, and their branchial pectinations form two equal spires, the *Sabelles simples* of M. Savigny. Such are *Amphritite reniformis*, Muller, or *Tubularia penicillus*, Id.; also *Terebella reniformis*, Gmelin, together with the *Amphritite infundibulum*, Montagu, and *A. vesiculosa*, Id.

There are some with a double range of filaments on each pectination—the *Sabellæ Astartæ*, Sav., such as *S. grandis*, Cuv., or *S. indica*, Sav., and the *Tubularia magnifica*, Shaw.

Others in which one pectination only is twirled, the others being smaller, and enveloped within the base of the first. The *Sabelles spirographes*, Sav., as *S. unispira*, Cuv., and *Spirographis Spallanzani*, Mart.

In some the gills do not form a simple funnel round the mouth, but numerous filaments, which are serrated and strongly ciliated on the internal face; the silky feet of these are almost imperceptible—such is *S. villosa*, Cuv.

Lastly, some have been described with six filaments disposed like a star—the *Fabricia* of Blainville.

TEREBELLA, Cuv.,—

Like the greater number of species of *Sabella*, inhabit a factitious tube, but which is composed of grains of sand, and fragments of shells; their body has much fewer rings, and the head is differently ornamented. Numerous filiform tentacles, capable of much extension, surround the mouth, and upon the neck are gills of an arbuscular, and not a fan-like form.

Fig. 200.—Terebella medusa, in its tube.

There are several on our coasts which were long confounded under the name of *Terebella conchilega*, Gm., and which are mosty remarkable for having their tubes formed of large fragments of shells, the aperture having its borders prolonged into several small branches formed of the same fragments, which serves to lodge the tentacles.

The greater number have three pairs of branchiæ, which in those with branched tubes pass through a hole for the purpose; they are the *Terebelles simples*, Sav.

AMPHITRITE, Cuv.—

Are easily recognized by their golden-coloured spines, disposed in a comb-like series, or in a crown, in one or several ranges upon the forepart of the head, and which probably serve them for defence, or perhaps to crawl with, or to gather up the materials for the tube. Around the mouth are very numerous tentacles, and on either side of the commencement of the back are pectinated gills.

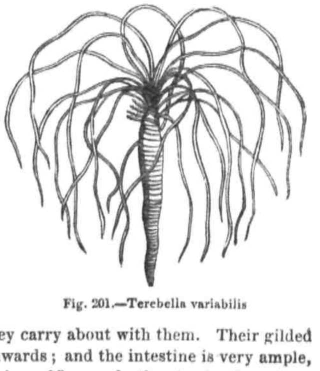

Fig. 201.—Terebella variabilis

Some of them compose slight tubes, of a regular conical form, which they carry about with them. Their gilded spines form two comb-like series, the teeth of which are directed downwards; and the intestine is very ample, and several times folded, being ordinarily full of sand; they are *Pectinaires* of Lamarck, the *Amphyctines*, Sav., the *Chrysodons*, Oken, and the *Cistena*, Leach. Such, upon our coasts, is the *A. belgica*, Gmelin, with a tube two inches long, formed of small round granules of various colours. A much larger species occurs in the Southern seas, *A. auricoma capensis*, Pallas, the slender and polished tube of which appears as though transversely fibrous, and formed of a soft fucus-stem-like substance, dried up.

There are some species which inhabit factitious tubes fixed to various substances. Their gilded spines form several concentric crowns upon the head, whence results an operculum that closes the tube when they contract into it, but which has two parts that can be spread asunder. They have a cirrhus on each foot. Their body

terminates behind into a tube recurved over the head, doubtless for the purpose of emitting their excrements. I have found in them a muscular gizzard.

Such upon our coasts is the *Sabella alveolata*, Gmelin, or *Tubipora arenosa*, Linn., the tubes of which, united into a compact mass, present orifices rather regularly disposed, like the cells of a honey-comb. The *Amphitrite plumosa*, Fabr., should perhaps range here, of which M. Blainville has formed his genus *Pherusa*. *Amph. ostrearia*, Cuv., establishes its tubes upon Oyster-shells, and is reputed to check the propagation of their inmates.

To this order I suppose must be approximated

THE SYPHOSTOMA, Otto,—

Which have a bundle of fine silky bristles above each articulation, a simple bristle below it, and at the fore extremity two bundles of stiff and gilded bristles, beneath which is the mouth, preceded by a sucker encircled by many soft filaments, that perhaps subserve the office of branchiæ, and which are accompanied by two fleshy tentacles. Their medullary nervous cord may be seen through the skin of the belly. They live deep in the mud.

The species are *S. diplochoites*, Otto, and *S. uncinata*, Aud. and Edw.

Lastly, in the vicinity of the same group, has lately been placed

DENTALIUM, Linn.,—

The species of which have a shell in form of an elongated cone, arcuated, and open at both ends, which may be compared to an Elephant's tusk in miniature; but the recent observations of M. Savigny, and especially of M. Deshayes, render this classification very doubtful.

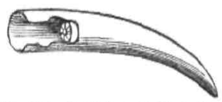
Fig. 202.—Dentalium entalis, in its tube.

The animal does not appear to have any appreciable articulations, nor lateral silky bristles; but it has a membranous tube, in the interior of which is a sort of foot, or fleshy and conical operculum, by which it closes the orifice. At the base of this foot is a small, flat head, and there are feather-like branchiæ upon the neck. If the operculum approximates the foot of the Tubulibranchiate Mollusks (*Vermetus* and *Siliquaria*), the gills are rather those of *Amphitrite* and *Terebella*. Further observations on their anatomy, and principally on their vascular and nervous systems, are required to solve this problem.

Different species have the shell angular, longitudinally striated, or round. Among the first are *D. elaphantinum*, Martini, &c.; among the second, *D. dentalis*, Rumpf.; and among the third, *D. entalis*, Martini.

THE SECOND ORDER OF ANNELIDES,—

THE DORSIBRANCHIATA,—

Have their organs, and particularly their gills, distributed about equally throughout the length of the body, or at least its middle portion.

We place at the head of them certain genera, in which the gills are more developed.

ARENICOLA, Lam.

Gills of an arbuscular form, upon the rings of the middle part of the body only. The mouth a fleshy trunk, more or less dilatable, but no discernible teeth, tentacles, or eyes. The posterior extremity of the body devoid not only of gills, but also of bundles of silky bristles, which occur on the other part; no cirrhus on any ring of the body. M. Savigny forms of them his family *Théléthuces*.

The common species (*Lumbricus marinus*, Linn.), is very abundant in the sand of the sea shore, where the fishermen dig for it to serve as bait. It is nearly a foot long, of a reddish colour, and diffuses, on being touched, a quantity of yellow fluid. It has three pairs of gills.

AMPHINOME, Brug.

A pair of branchiæ in form of a crest, or a tuft more or less complicated, on each ring of the body, and two bundles of separate bristles, together with two cirrhi, upon each foot. The trunk or proboscis without jaws. These form the family of *Amphinomes* of M. Savigny, who divides them into

Chloeia, wherein are five tentacles to the head and gills in form of a tripinnate leaf. There is one in the East Indies (*Terebella flava*, Gm.), extremely remarkable for its long citron-coloured bundle of bristles, and for its splendid purple tufts of branchiæ. Its form is broad and depressed, and it has a vertical crest on the muzzle.

Plëione, Sav. (*Amphinome*, Blainv.), which, with the same tentacles, have crest-like gills. These also are from the East Indies, and attain a great size.

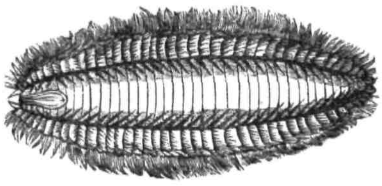

Fig. 203.—Euphrosine laureata.

To these may be added *Euphrosine*, Sav., which has but one tentacle to the head, together with arbuscular gills, very much developed and complicated; and to which the genus *Anisteria*, Sav., established on a mutilated individual, should probably be approximated; and, lastly,

Hipponoe, Audouin & Edwards, which, devoid of caruncle, has only one cirrhus and packet of bristles to each foot. There is one at Port Jackson, *H. Gaudichaudii*, Aud. & Ed.

EUNICE, Cuv.—

Is likewise furnished with tuft-like gills, but the trunk is formidably armed with three pairs of differently-formed horny jaws; each of their feet has two cirrhi and a bundle of bristles; and there are five tentacles upon the head above the mouth and two on the neck. Some species only exhibit two small eyes. M. Savigny's family of *Eunices* is constituted by this division, and the particular genus is termed by him *Leodice*.

A species, from one to four feet in length, inhabits the sea around the Antilles (*E. gigantea*, Cuv.), which is the largest Annelide known. Some upon our coasts are much smaller.

M. Savigny distinguishes by the name of *Marphisia* certain species, otherwise very similar, which have no nuchal tentacles, and the upper cirrhus of which is very short, as *Nereis sanguinea*, Montagu. An allied species (*N. tubicola*, Muller), inhabits a horny tube.

After these genera with complex branchiæ, are placed those in which the organs adverted to are reduced to simple laminæ, or even to slight tubercles, or which, lastly, are represented only by the cirrhi. Some of them resemble Eunice by the powerful armature of the trunk, and by their antennæ of unequal number. Such are

LYCIDICE, Sav.,—

Which, together with the jaws of Eunice, or even a greater number than in that genus, and often unequal on the two sides, have but three tentacles, and cirrhi to perform the office of branchiæ.

AGLAURA, Sav.—

Have likewise numerous jaws, of an unequal number, seven, nine, &c.; but no tentacles, or which are entirely hidden; and the gills are similarly reduced to cirrhi.

Under this name I unite the *Aglaura* and *Œnone* of Savigny, and even certain species without tentacles, which MM. Audouin and Edwards leave in *Lycidice*, as *Ag. fulgida* and *Œ. lucida*.

THE NEREIDS, properly so called (*Nereis*, Cuv.; *Lycoris*, Sav.).

Tentacles of an even number, attached to the sides of the base of the head, two other biarticulated ones a little more forward, and between these two simple ones; only one pair of jaws within the trunk; the gills formed of little laminæ, traversed by a network of vessels; and at each of their feet two tubercles, two bundles of bristles, and a cirrhus above and below.

A great number of species inhabit our coasts.

[The species here figured, *N. prolifera* (Muller, *Zool. Dan.*), exhibits a singular peculiarity in its mode of propagation, merely by spontaneous division, the hind part of the body being gradually transformed into an additional animal, the head and tentacular cirrhi being already developed. Muller describes one mother, to which three fœtuses, of different ages, appeared in one length. The mother had thirty segments, the young one nearest to it had eleven, and the two hinder, or older ones, seventeen segments each.]

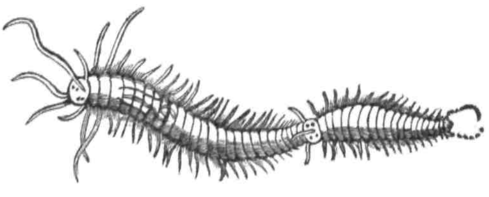

Fig. 204.—Nereis prolifera.

After these should rank various genera, equally distinguished by a slender body, and gills reduced to simple laminæ, or even to simple filaments or tubercles. Several, however, have no jaws nor tentacles.

PHYLLODOCE, Sav. (*Nereiphylla*, Blainv.),—

In common with the Nereids proper, have tentacles of even number at the sides of the head, and four or five small ones anteriorly. They have distinct eyes; their large trunk is furnished with a circlet of very short fleshy tubercles, does not contain jaws, and, what particularly distinguishes them, their

gills are in the form of very broad leaves, forming a range on each side of the body, upon which minute vessels ramify extensively.

The *N. viridis*, Muller, of which M. Savigny, without having seen it, proposes to make a genus *Eutalia*, and the two species of *Eunomia*, Risso, appear to me to belong to *Phyllodoce*, to which also, perhaps, should be referred the *Nereis pinnigera*, Montagu, and the *N. stillifera*, Muller, which M. Savigny, without seen them, proposes to make into a genus *Lepidia*, and *N. longa*, Otto, which M. Savigny places with *N. flava* in his genus *Etiona*. All these require to be examined anew after the method detailed by M. Savigny. The genus *Phyllodoce*, Sav., however, must not be confounded with that of M. Ranzani, which latter is allied to *Aphrodita*, and especially to *Polynoe*.

ALCIOPE, Aud. & M. Edwards,—

Have nearly the mouth and tentacles of Phyllodoce, but the feet present, besides the tubercle which bears the bristles and the two foliated cirrhi, or gills, a couple of branchial tubercles, which occupy its upper and lower borders.

SPIO, Fabricius & Gmelin.

A slender body; two very long tentacles that have the appearance of antennæ; eyes upon the head, and on either side of each segment of the body a gill in form of a simple filament. They are small northern Sea-worms, which inhabit membranous tubes.

Polydore, Bosc., appears to me to be referrible to this genus.

SYLLIS, Sav.—

Have tentacles of uneven numbers, articulated in chaplets, together with upper cirrhi to the feet, which are very simple, and bear no bundles of silky bristles. It appears that they vary with respect to the existence of jaws.

S. monilaris, Sav. [figured in p. 391 *ante*], the *Nereis armillaris*, Muller, of which M. Savigny, without having seen it, proposes to make a genus, which he terms *Lycastis*, having tentacles and cirrhi in chaplets, like a Syllis; but the former, represented to be of even number, requires farther examination.

GLYCERIS, Cuv.—

Are recognized by the form of the head, which terminates in a conical fleshy point, having the aspect of a small horn, and the summit of which divides into four very small tentacles, that are scarcely visible. The trunk of some of the species contains jaws, which cannot be perceived in others.

Such are *Nereis alba*, Muller, and *Glyc. Meckelii*, Aud. & Edw.

NEPHTHYS, Cuv.

The trunk of Phyllodoce, but no tentacles; and on each foot two bundles of bristles widely separated, and a cirrhus between them.

LOMBRINEREIS, Blainv.—

Have no tentacles; the body, considerably elongated, has merely a small forked tubercle at each articulation, which bears a little packet of silky bristles. If there be any external respiratory organ, it can only be the upper lobe of this tubercle.

Nereis abranchiata, Poll., *Lumbricus fragilis*, Muller, of which latter M. Blainville makes, but doubtfully, his genus *Scoletome*.

The *Scolelepe*, Blainv., which are only known by the figure of Abildgaart (*Lumbricus squamatus*), have a very slender body, with numerous rings, each of which has a cirrhus that serves for a gill, and two bundles of silky bristles, the lower of which seems to consist of a fold of skin compressed like a scale, and the head has neither jaws nor tentacles.

ARICIA, Sav.,—

Have neither teeth nor tentacles. The body, which is lengthened, bears two ranges of lamelliform cirrhi along the back; and the anterior feet are furnished with dentelated crests, that do not occur on the other feet.

Ar. Cuvieri, Aud. and Edw. The *Lumbricus armiger*, Muller, which M. Blainville, without having seen it, proposes to make a genus of, by the name of *Scolople*, appears to have neither teeth nor tentacles, and bears two small simple bundles of short bristles on its first segments, and on the rest a bifid tubercle, a little bristle, and a long and pointed branchial lamina.

HESIONE,—

Have a short and rather thick body, composed of few ill-defined rings: a very long cirrhus, which probably fulfils the office of branchiæ, occupying the upper part of each foot, which has also another lower one, and a packet of silky bristles, and the trunk large, having neither jaws nor tentacles.

Such are *H. splendida*, Savigny, *H. festina*, Id., and *H. pantherima*, Risso.

OPHELINA, Sav

Body rather thick and short, the rings ill-defined, bristles scarcely visible, and long cirrhi serving for gills upon two thirds of its length; the mouth containing a dentelated crest at the palate, lips surrounded with tentacles, of which the two uppermost are larger than the rest.

Hereabouts should probably be placed the *Nereis prismatica* and *bifrons* of Fabricius.

CIRRHATULA, Lam.

A very long filament serving for gills, and two little bundles of bristles at each articulation of the body, which are very numerous and much serrated, together with a collar of long filaments around the neck. Head ill-defined, with neither tentacles nor jaws.

Lumbricus cirrhatus, Otto, from which the *Terebella tenticulata*, Montagu, and the *Cirrhinereis filiger*, Blainville, do not appear to me to differ generically.

PALMYRE, Sav.

Distinguished by their upper bundle composed of large flattened bristles disposed like a fan, and brilliant as the most polished gold; the inferior bundles small; their cirrhi and gills not very distinct. They have a lengthened body, and two long and three very small tentacles.

One only is known, from the Isle of France, two inches in length, the *P. aurifera*, Savigny.

APHRODITA, Linn.

Easily known from the rest of this order by two longitudinal ranges of broad membranous scales, covering the back, to which the name *elytra* has been given without much reason, and under which the gills lie concealed in form of little fleshy crests. The body is generally flattened, and shorter and broader than in other Annelides. A very thick and muscular œsophagus is observable on dissection, which is capable of being reversed into a trunk externally; the intestine is unequal, and furnished on each side with a great number of branched cœca, the extremities of which are fixed between the bases of the packets of silky bristles which serve for feet.

M. Savigny distinguishes among them the

HALITHEA,—

Wherein are three leaflets, between two of which is a very small crest, and which also has no jaws.

There is one upon our coasts, which is among the most beautifully coloured of animals (*Aphrodita aculeata*, Linn.) Its form is oval, six or eight inches long, and two or three broad. The scales of its back are covered and concealed by a substance resembling tow, which originates at its sides: the latter have also groups of stout spines, which partly pierce the tongue, together with bundles of flexible bristles, as brilliant as gold, and changeable to every hue of the rainbow. The colours they present are surpassed in beauty neither by the scale-like feathers of the Humming-bird, nor by the most brilliant gems. Below them is a tubercle bearing three groups of spines, of three different thicknesses; and finally, a fleshy cover. There are forty of these tubercles on each side, and between the two first are two little fleshy tentacles; besides which there are fifteen pairs of broad scales, which are sometimes bulged upon the back; and fifteen small branchial crests on each side.

[The animals of this group, which greatly resemble, in form, the *Euphrosine laureata*, figured in a preceding page, are well known under the name of Sea Mice, and are often thrown upon the beach after a gale of wind. In some species the lateral setæ exhibit a beautiful structure, admirably fitting them for weapons of defence, being barbed on each side at the tip; but, in order to prevent the injury which might occur to the animals, in consequence of the power it possesses of retracting these setæ, each is inclosed in a smooth, horny sheath, composed of two blades.]

Some species have no tow-like substance on the back, which are the *Halithus hermiones* of M. Savigny, and form the genus *Hermione* of M. de Blainville. There is one in our seas, the *Aphr. hystrix*, Savigny.

Another division of Aphrodita is the

POLYNOE, Sav. (*Eumolpe*, Oken),—

Having no scales on the back, and five tentacles, together with strong corneous jaws, within the proboscis.

Several small species inhabit our coasts.

SIGALION, Aud. and Edw.,—

Presents a more elongated form than other Aphrodites, with cirrhi upon all the feet.

ACOETES, Id.,—

Have cirrhi which alternate with the elytra for a considerable space, and stronger and better dentelated jaws.

The Antilles possess a large one, which inhabits a tube of the consistence of leather. The *Phyllodoce maxillosa*, Ranzani, named *Polyodante* by Reinieri, and *Eumolpe maxima*, Oken, appear to be nearly allied, having the same trunk and jaws, and neither genus having perhaps been described from perfect specimens. Many species of Annelides remain, which have been too imperfectly described to admit of their being characterized; and the *Myriane*, and two or three other genera of M. Savigny, must remain to be examined anew.

Finally, we place here a new and very singular genus, which I name

CHÆTOPTERUS.

Mouth with neither jaws nor trunk, but furnished above with a lip, to which three small tentacles are attached. A disk then follows with nine pairs of feet, after which is a pair of long silky bundles like two wings. The lamina-formed gills are attached more towards the upper surface than the lower, and range along the middle of the body.

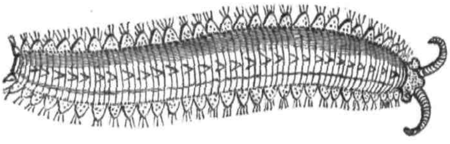

Fig. 205.—Peripatus Iuliformis.

[Here also ought probably to be placed the genus *Peripatus* of Guilding, founded upon a West Indian species, which burrows in the sand, and which has much perplexed naturalists as to its relations. By Guilding it was considered as molluscous; by Mac Leay as forming the passage between the *Iulidæ* and the annulose annelidous worms; whilst Gray (*Zool. Misc.* p. 6) asserts that it is annelidous, and connects *Nereis* with *Lumbricus*.]

THE THIRD ORDER OF THE ANNELIDES,—

ABRANCHIA,—

Have no respiratory organ appearing externally, and seem to respire either, as in the Earthworms, over the whole surface of the skin, or, as in the Leeches, by internal cavities. Some of them have yet bristles to serve for locomotion, of which others are deprived, and they accordingly fall into two families.

THE FIRST FAMILY OF THE ABRANCHIA,—

THE ABRANCHIA SETIGERA,—

Which are provided with silky bristles, comprise the Earthworms and Naides of Linnæus.

THE EARTHWORMS (*Lumbricus*, Linn.)—

Are characterized by a long, cylindrical body, divided by transverse furrows into a great number of rings, and by a mouth without teeth: they require to be thus subdivided:

THE TRUE EARTHWORMS (*Lumbricus*, Cuv.)—

Have neither eyes, tentacles, gills, nor cirrhi: a distinct enlargement, particularly during the breeding season, indicates where they attach themselves to one another in the act of copulating. Internally they have a straight, wrinkled intestine, and some whitish glands towards the fore part of the body, which appear to serve for generation. It is certain that they are hermaphrodite, and it seems that their contact only serves to excite each other to self-fecundation. According to M. Montègne, the eggs descend between the intestine and external envelope, as far as around the rectum, where they hatch, the young crawling out alive by the anus. M. Dufour states, on the contrary, that they deposit eggs analogous to those of the Leeches. Their nervous chord consists of a series of an infinitude of little ganglia, serrated one against another.*

M. Savigny subdivides them further into *Enterion*, having on each ring four pairs of little bristles, eight throughout, to which belongs

The Common Earthworm (*L. terrestris*, Linn.).—This well-known species attains to nearly a foot in length, with

* This is common to very many species, as M. Savigny first observed. As many as twenty have been been characterized. M. Duges only distinguishes six

120 or more rings; the bulge is towards its anterior third. Under the sixteenth ring are two pores, of which the use is unknown. It pierces the ground in all directions, perforating it remarkably well, and subsists on roots, woody fibres, animal matter, &c. In the month of June it searches at night above ground for a mate.

[It is especially in rich and well-manured soils that the Earthworm delights, particularly in gardens and meadows; they are extremely sensitive to movements of the earth; and anglers, knowing well their temerity in this respect, take advantage of it, in order to obtain a supply of these animals for baits, by introducing a spade or fork into the ground, and stirring the soil, when they soon appear on the surface. We are indebted to Charles Darwin, Esq., for a remarkable and interesting memoir on the utility of this animal, read before the Geological Society. The worm casts, which so much annoy the gardener by deforming his smooth-shaven lawns, are of no small importance to the agriculturist; and this despised creature is not only of great service in loosening the earth, and rendering it permeable by air and water, but is also a most active and powerful agent in *adding to the depth of the soil*, and in covering comparatively barren tracts with a superficial layer of wholesome mould. The author's attention was directed by Mr. Wedgwood, of Maer Hall, Staffordshire, to several fields, some of which had a few years before been covered with lime, and others with burnt marl and cinders, which substances in every case are now buried to the depth of some inches below the turf, just as if, as the farmers believe, the particles had worked themselves down. After shewing the impossibility of this supposed operation, the author affirms that the whole is due to the digestive process by which the common Earthworm is supported, since, on carefully examining between the blades of grass in the fields above-mentioned, he found that there was scarcely a space of two inches square without a little heap of the cylindrical castings of worms; it being well known that worms swallow earthy matter, and that having separated the serviceable portion, they eject at the mouth of their burrows the remainder in little intestine-shaped heaps. Still more recently Mr. Darwin has noticed a more remarkable instance of this kind, in which, in the course of eighty years, the Earthworms had covered a field then manured with marl, with a bed of earth, averaging thirteen inches in thickness.]

[Fig. 206, *b*, represents the anterior extremity of the Earthworm, to show the mouth, as well as the setæ *directed backwards* upon the segments of the body, by means of which it is admirably enabled to work its way through the earth, their backward direction enabling it to retain its station as it protrudes its head further into the earth. *Fig. c*, represents one of its eggs, inclosing, as is sometimes the case, two young; and fig. *d* represents the escape of the young worm from the egg, the anterior extremity of which is furnished with a peculiar valve-like structure; these two figures are highly magnified.]

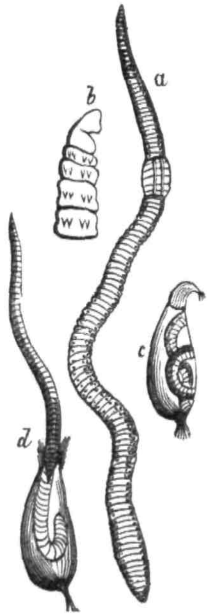

Fig. 206.—Lumbricus terrestris.

Hypogæon, Sav., have an additional single, or uneven, bristle upon the back of each ring. They are only known in America.

MM. Audouin and M. Edwards likewise distinguish the *Trophonius*, which has four bundles of short silky bristles on each ring, and at the anterior extremity a great number of long and brilliant bristles, encircling the mouth.

THE NAIDES (*Nais*, Linn.),—

Have the elongated body and the rings less marked than in the Earthworms. They live in holes which they perforate in mud at the bottom of water, and from which they protrude the anterior portion of the body, incessantly moving it. Some have black points upon the head, which have been regarded as eyes. They are small worms, the reproductive power of which is as astonishing as that of the Hydra or Polypus. Many species exist in our fresh waters.

Some have very long bristles; others (the *Stylaria*, Lamarck) a long protrusile trunk; several (*Proto*, Oken) have small tentacles at the hind extremity, and there are others with very short bristles.

To this genus may be approximated certain Annelides allied to the Earthworms, which fabricate the tubes of clay, or debris, into which they retire.

Such are the *Tubifex* of Lamarck, which, however, requires further examination.

CLIMENE, Sav.,—

Appears likewise to belong to this family. Their body is rather thick, with few rings, and bears, for the greater portion of its length, a range of strong bristles, and, a little higher up, a bundle of finer bristles on the dorsal aspect. The head has neither tentacles nor appendages; posterior extremity truncated and rayed, and they also inhabit tubes.

THE SECOND FAMILY OF THE ABRANCHIOUS ANNELIDES,—OR,

THE ABRANCHIA WITHOUT BRISTLES,—

Comprise two great genera, both of which are aquatic.

THE LEECHES (*Hirudo*, Linn.)—

Have an oblong body, sometimes depressed, and wrinkled transversely; the mouth encircled by a lip, and the posterior extremity furnished with a flattened disk, both ends being adapted to fix upon bodies by a kind of suction, by means of which these animals move, for, having fixed their anterior extremity, they draw the other up to it and fix that, and then readvance the first, [besides which, they swim with facility]. Several have a double series of pores underneath the body, which are the orifices of little internal pouches, considered by some naturalists as organs of respiration, although they are generally filled with a mucous fluid. The intestinal canal is straight and swoln at intervals, extending for two thirds the length of the body, where there are true cœca. The blood they swallow continues red, and without alteration, for several weeks. The ganglia of their nervous system are much more separated than those of the Earthworms. They are hermaphrodite, and have a large penis about the anterior third of the body, and a vulva a little behind it. Several accumulate their eggs into cocoons enveloped by a fibrous excretion.

Fig. 207.—Hirudo officinalis; a, its anterior extremity, shewing the sucker.

[On opening the Leech shortly after it has gorged itself with the blood of its prey, it will be found that none of the blood has passed into the intestines. The operation of digestion is extremely slow, notwithstanding the rapid and excessive manner in which the Leech fills its stomach: a single meal of blood will suffice for many months, nay, more than a year will sometimes elapse before the blood has passed through the intestines in the ordinary manner, during all which period so much of the blood as remains undigested in the stomach continues in a fluid state, and as if just taken in, notwithstanding the vast difference in the heat of the body of a mammiferous animal and that of a Leech.] —*Griffith, An. King.*, part 35, p. 129.

They are subdivided upon characters derived principally from the organs of the mouth. In

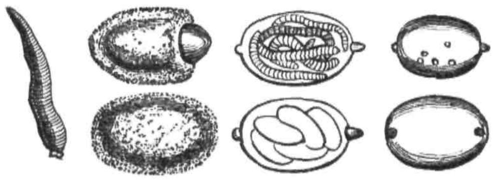

Fig. 208.—Developement of Hirudo medicinalis.

THE LEECHES, properly so called (*Sanguisuga*, Sav.),—

The anterior sucker has the lip divided into several segments; its aperture is transversal, and contains three jaws, each armed with a double range of very fine trenchant teeth, which enable them to pierce the skin without inflicting a dangerous wound: they have ten minute points, which have been considered as eyes.

Every one is acquainted with the medicinal Leech (*H. medicinalis*, Linn.), so useful an instrument for local blood-letting.

HÆMOPIS, Sav.,—

Differs by having the teeth less numerous and comparatively obtuse.

Such is the common Horse Leach, (*H. sanguisorba*, Sav.).

BDELLIA, Sav.,—

Has only eight eyes, and no teeth whatever.

There is one in the Nile (*Bd. nilotica*, Egypt. Ann.)

NEPHELIS, Sav.,—

Has also but eight eyes, and the mouth with only three folds of the skin interiorly.

M. de Blainville terms them *Erpobdellis*, and M. Oken *Helluo*.

Numerous small species inhabit our fresh waters, among which should be distinguished

TROCHETIA, Dutrochet,—

Which differ by having a bulge at the genitals.

A species (*Geobdella trochetii*, Blainv.), is often seen upon the ground, pursuing the Earthworms.

M. Moquin Tandon has described a subgenus by the name of *Aulastoma*, the mouth of which has merely longitudinal folds, several in number.

In the suite of *Nephelis*, should be placed the *Branchiobdellia* of M. Odier, remarkable for having two jaws and no eyes.

One species only is known, which lives upon the gills of the Crab.

All these subdivisions have the anterior sucker a little separated from the body: the two next are distinguished by a further separation, composing almost a segment, having a transverse aperture.

HÆMOCHARIS, Sav.,—

In addition to this conformation, have eight eyes, a slender body, and rings not very distinct. Their jaws do not project, and are scarcely visible: they do not swim, but advance in the manner of the caterpillars termed geometrical, and attach themselves particularly to fishes. They are the *Piscicola* of Blainville, and the *Icthiobdella* of Lamarck.

One species is common upon the Carp, (*H. piscium*, Linn.).

ALBIONES, Sav. (*Pontobdella*, Leach and Blainville),—

Differ from the preceding by having the body bristled with tubercles, and eyes only six in number. They live in the sea.

There is a parasite on the Torpedo, named *Branchellion*, very similar to a Leech, but which appears to have a little mouth at the hind border of its anterior disk, which last is borne on a slender neck, and at the base of it is a small hole for the generative organs. The lateral edges of its folds, which are compressed and salient, have been regarded as branchiæ, but I cannot perceive vessels ramifying upon them; the epidermis is ample, and envelopes the creature like a very loose sac.

CLEPSINES, Sav. (*Glossoporis*, Johnson),—

Ranks commonly also among the Leeches. The body is widened, with a disk only behind, and the mouth is formed into a trunk, and not suctorial; but it is not impossible that some of these belong to the family of *Planariæ*. *Phillines*, Oken, and *Malacobdellis*, Blainv., have also a widened body, and want the anterior sucker. Their habits are parasitic.

THE GORDIANS (*Gordius*, Linn.),—

Have the body in form of a filament; slight transverse folds, which mark the articulations only; and no feet, branchiæ, or tentacles have yet been discerned; nevertheless, they are internally distinguished by a knotted nervous chord. They should perhaps be placed, however, with the intestinal worms, such as the *Nemertes*.

The various species inhabit fresh water, mud, and inundated grounds, which they perforate in all directions &c. [We have not unfrequently met with them upon garden-cabbages, and their name is derived from the complex knots into which they seemingly entangle their extremely elongated bodies.] The commonest (*G. aquaticus*, Linn.), is several inches long, and scarcely thicker than a hair. See the memoir of Dr. George Johnston on this species in the *Magazine of Natural History*, vol. ix. p. 359.] [This animal, which is found in slowly-running and stagnant waters in the summer, is commonly mistaken for the species of Filaria, the proper habitat of which is the intestines of Beetles and other insects. The head of Gordius is obtusely conical, with a simple circular terminal pore for a mouth, from which a sort of membrane can be forced by pressure. The tail is bifid; the processes short, equal, and obtuse; the latter has often been mistaken for the mouth. Thus Dr. Turton describes the mouth as "small, horizontal, with equal obtuse jaws." Dr. Johnston states, that having cut off portions of the anterior extremity and tail, the detached parts soon lost every sign of life; it has, however, been asserted, that each part would grow into a perfect animal.]

Fig. 209.—Gordius aquaticus

INTRODUCTION TO THE ARTICULATED ANIMALS WITH ARTICULATED LEGS.*

BY M. P. A. LATREILLE.

Overwhelmed by the variety of his occupations, and yielding too easily to the impulse of friendship, M. Cuvier has confided to me the portion of this work which treats upon insects.

These animals were the objects of his earliest studies in zoology, and hence originated his friendship with Fabricius, one of the most celebrated disciples of Linnæus, who has repeatedly, in his works, shown evidences of his particular esteem. Various interesting observations upon some of these animals, published in the *Journal d'Histoire Naturelle,* formed the prelude to his works upon natural history. Entomology, like the other branches of zoology, has derived the greatest advantages from his anatomical researches, and the happy modifications which he has thence made in the groundwork of our classification. The external structure of insects has been better understood; and this branch of the science has no longer been neglected, as it had previously been. His *Tableau Elémentaire de l'Histoire Naturelle,* and *Leçons d'Anatomie Comparée,* have pointed out the path to the natural method. The public will therefore have cause to regret that his numerous pursuits would not permit him to undertake this portion of his treatise upon animals.

In undertaking this work, my object has been to unite, in as narrow limits as possible, the most striking facts in the history of insects; to arrange these animals with precision and clearness, in a natural series; to sketch their physiognomy; to trace, in as few words as possible, their distinguishing features, adopting a plan which shall be in relation to the progressive advance of the science and of the student; to notice the beneficial and obnoxious species,—indicating, at the same time, the best sources where he may attain a knowledge of the other species; to reduce the science to the engaging simplicity which it exhibited in the days of Linnæus, Geoffroy, and the earlier works of Fabricius, and yet to present it as it now appears, enriched but not overcharged with recent observations and researches;—in a word, to make it conformable to the work of Cuvier.

This author, in his *Tableau Elémentaire de l'Histoire Naturelle des Animaux,* did not limit the extent of the class of insects, as restricted by Linnæus, but introduced neces-

* [These introductory observations appeared in both editions of the *Règne Animal*, the object of Latreille being herein to set forth the general principles upon which his arrangement of the Linnæan insects was founded. In the second edition, the same general classification was adopted, but considerable alterations were made in the arrangement of the secondary and tertiary groups, such as families, genera, &c., it having been impossible to bring the work down to the then present state of the science, without modifying the former arrangement, and making great additions; so that two volumes were requisite instead of one, to give a summary of the multitudinous genera published in the intervening period. In like manner, the internal anatomy of these animals had been greatly studied,—thereby, in many instances, *affording more certain proofs of the solidity of many of the groups previously proposed*, and of whose internal structure it therefore became necessary to add the details to the generally external character previously given; so that this second edition ought more strictly to be regarded as an entirely new work.]

*** Throughout the Articulated portion of the present edit' original passages are enclosed in editorial parentheses, thus

sary modifications, which have served as the basis of other subsequent classifications. He at first characterized insects from other invertebrated animals, by more rigorous characters than had been before employed,—namely, a knotted or ganglionated nervous chord, extending down the body, and articulated limbs. Linnæus terminated his class of insects with those which are destitute of wings, although some of them—as the crabs and spiders—are, in respect to their organic systems, the most perfectly organized (*les plus parfaits*) of the class, and consequently the nearest to the molluscous animals. This arrangement is therefore opposed to the natural system; and M. Cuvier, by placing the Crustacea at the head of the class, succeeded by the other apterous insects, has rectified the method in a point where the series was in opposition to the scale formed by nature.

In his *Leçons d'Anatomie Comparée*, the class of insects, after the removal of the Crustacea, was divided into nine orders, founded upon nature, or the functions of their mouth-organs, and the variations in their wings, thus uniting the principles of the Linnæan and Fabrician arrangements. [1st. Those with maxillæ, five orders: Gnathaptera (including the majority of the Linnæan Aptera, after the removal of the Crustacea), Neuroptera, Hymenoptera, Coleoptera, and Orthoptera; and, 2nd, those without maxillæ, four orders: Hemiptera, Lepidoptera, Diptera, and Aptera.] The groups established by Cuvier in his Gnathapterous order are nearly identical with those which I proposed in a Memoir presented to the Société Philomatique, in April, 1795, and in my *Précis des Caractères Génériques des Insectes*, in which I divided the Linnæan Aptera into seven orders:—1. Suctoria; 2. Thysanura; 3. Parasita; 4. Acephala (the Arachnides palpistes of Lamarck); 5. Entomostraca; 6. Crustacea; 7. Myriapoda.

Lamarck's arrangement of the Linnæan Aptera appears, however, to make the nearest approach to a natural system; and we have adopted it, with certain modifications, which we will now explain. With him, I divide the Linnæan insects into three classes:—CRUSTACEA, ARACHNIDA, and INSECTA; but I do not employ the characters derived from metamorphosis;—these, although natural, and already employed by De Geer, not being classical (*classique*), presupposing the observation of the animal in its different states, which has been so much neglected. I have not, however, entirely neglected these characters; and, indeed, a Memoir which I have prepared upon the metamorphoses of insects, not yet published, has been resorted to in the general observations upon the different groups.

In the class CRUSTACEA, I have established five apparently natural orders, founded upon the situation and form of the branchiæ, the manner in which the head is articulated with the thorax, and the mouth-organs; and I have terminated this class, like Lamarck, with the Branchiopoda, which are a kind of Crustaceous Arachnida.

In the class ARACHNIDA, I only comprehend the Arachnides palpistes of Lamarck, and which thus constitute a group well characterized, both internally [from the structure of their respiratory apparatus] and externally, from their being destitute of antennæ, and have ordinarily four pairs of feet. I divide this class into two orders: namely, the Pulmonaria and Trachearia.

The class of INSECTA is characterized in a very simple manner by the system of respiration consisting of two air tubes running along the sides of the body, furnished at intervals with centres of ramifications, corresponding with the [external] spiracles, and by the possession of two antennæ. The primary groups of insects are founded upon

the following considerations :—1st, Wingless insects, with incomplete metamorphoses, or which do not undergo any change, comprising the first three orders; 2ndly, Wingless insects, undergoing complete metamorphoses, comprising the fourth order; and, 3rdly, Insects with wings, which they acquire by metamorphosis, either of an incomplete or perfect kind, containing the last eight orders. The first of these primary groups corresponds with Lamarck's Arachnides antennistes; the second, consisting of the single genus Pulex [or the flea], appears, in some respects, to be related by means of the genus Hippobosca [or forest flies], with the order Diptera, although, in other respects, and in its metamorphoses, it is removed from the genus last named. It is, moreover, often difficult to distinguish these natural enchainments; and often, even when discovered, we are compelled to sacrifice these relations to the precision and facility of our [artificial] methods.

To the before known orders of insects I have added that of Strepsiptera (*Kirby*), but under the name of Rhipiptera,—the former appearing [but erroneously] to me to be founded upon an incorrect supposition. Perhaps, indeed, this order might be suppressed, and united with the Diptera, as Lamarck had suggested.

For the reasons assigned in my *Considérations Générales, &c.*, p. 46, and which I might support by other proofs, I have attached more weight to the characters derived from the organs of locomotion, and the general construction of the body, than to the modifications of the mouth-organs, at least when their structure is referable to the same type. Hence I do not divide the class first into gnawing and sucking insects, but into those with wings, or wing-cases, &c., nearly similar to the series of the Linnæan orders, using, in a secondary sense, the characters derived from the mouth-organs, which had been placed in the foremost rank by Fabricius, Cuvier, Lamarck, Clairville, and Dumeril, whose arrangements consequently differ from mine.

I have followed Cuvier in reducing the number of families proposed in my former works, and in converting into subgenera the groups separated from the Linnæan genera, although their characters appear to be sufficiently distinct. Such was also the plan of Gmelin, which is simple and advantageous, by bringing the subject more within the capacity of the student.

All my groups are founded upon the comparative investigation of all the parts of the animals which I desire to make known, and upon the observation of their habits. It is from being too exclusive in their considerations, that the majority of naturalists entirely lose sight of the natural system (*l'ordre naturel*).

To the facts recorded by Réaumur, Roesel, De Geer, Bonnet, the Hubers, &c., upon the instincts of insects, I have added many collected by myself; while the works of Cuvier, L. Dufour, M. Serres, Strauss, Audouin, and Milne Edwards, have furnished me with anatomical observations. As I have been able to describe but a very small number of insects, I have selected the commonest and most interesting species.

[Such is a condensed abstract of the introductory observations of Latreille, from which it will be seen that the period of ten years, which had elapsed between the publication of the first and second editions of this work, had rendered it necessary to double the space assigned to the Linnæan Insecta, which, in the second edition, occupied upwards of 1100 pages. The latter was published in 1829; and if we contrast the ten years which have elapsed since that period with the ten preceding, we shall be com-

pelled to admit that Entomology has made far more rapid strides in these days than heretofore. The establishment of Entomological Societies in France and England has called forth the exertions of many students, who, in every branch of the science, have added greatly to our knowledge of these tribes of animals; but it has been especially with reference to the description of new genera and species that the greatest strides have been made. To attempt, within the very limited space devoted in this edition to the Invertebrated Animals, to give even a list of all the new genera established since 1829, would be useless; and this portion of the work must therefore necessarily be treated in a plan somewhat at variance with that of the vertebrated portion. As we cannot, therefore, give the genera, subgenera, sections, subsections, and other inferior groups, which, in the majority of instances, rest upon isolated structural characters, often of trivial nature (such as the number of joints in the antennæ, the number of cells or spaces formed by the veins of the wings, &c.), I shall confine myself more especially to those natural groups which Latreille, in his other works, regarded as "natural families,"—groups equivalent in general with the Linnæan genera, to which but few additions of importance have been made, and of which the knowledge will afford a good and sufficiently general view of Entomology,—noticing, however, their sectional distribution, and the more remarkable of the groups now termed genera.

It is in the first place, however, necessary to observe, that the limits of the sub-kingdom Articulata, and its primary divisions, have recently formed the subjects of much discussion. The researches of Drs. Nordmann, V. Thompson, and Burmeister have clearly proved, not only that the Cirrhipedes, placed by Cuvier amongst the Mollusca, are, in their earlier stages, active Entomostraca; but also that the Lernææ, placed by Cuvier amongst the intestinal worms, are similarly active, and furnished with articulated legs in their early state. The relation of the Annelides with some of the wingless insects has also been strenuously maintained by some writers, who have deemed the internal organisms of higher importance than the circumstance of the limbs being articulated.

With respect to the primary divisions, or classes, into which the jointed-legged Articulata (or the Condylopa of Latreille) are formed, it is to be observed that Latreille himself, in his *Cours d'Entomologie*, published subsequently to the second edition of this work, has modified his views herein set forth, in the following manner:—

CONDYLOPA—(*Insecta*, Linn.)

1. APIROPODA.—With more than six feet; destitute of wings.
   - Class 1. Crustacea.
   - 2. Arachnides.
   - 3. Myriapoda.
2. HEXAPODA.—Including the single
   - Class 4. Insecta.*

Here we find the Myriapoda, which Latreille had in this work united with the true insects, raised to the rank of a class, whilst the orders Thysanura and Anoplura (*Parasita*, Latr.) still remained with the fourth class.

Mr. M'Leay, however, has united these two orders with the Myriapoda, forming

* [Without attaching so much weight to considerations resting solely upon analogical resemblances, too often of a very fanciful nature, as some of our recent English naturalists (M'Leay, Swainson), we may notice that these four groups seem to represent the four primary groups of vertebrated animals. The Crustacea are aquatic, and, as such, are analogous to fishes. *The Arachnida are terrestrial*, and thus indicate the Mammalia. That the Myriapoda are analogous to the reptiles is sufficiently evident by comparing a Scolopendra with the skeleton of a Snake, or an Iulus with a perfect one (whence Latreille named the latter Anguiformes); whilst the true insects, furnished with wings, at once represent the only other winged class—*that of birds.*]

them, with certain worms, into a class, for which he adopted Leach's name, Ametabola (changeless), in order to distinguish them from the true insects, which undergo transformations. This author retained the classes Crustacea and Arachnida, but divided the insects, from the structure of their mouth-organs, into those with mandibles and those with a suctorial mouth,—characters which we have seen had been employed in the arrangement of the orders of insects *inter se*.

Other arrangements have been proposed by Kirby and Spence, Burmeister, &c., to which I can but refer.—I shall, therefore, only add that it appears to me most natural to confine the Ametabola to the Myriapoda, Thysanura, and Anoplura; to unite the winged insects into one class, named Ptilota, after Aristotle; and to retain the Crustacea and Arachnida in the limits here detailed.—*Entomol. Text-Book*, p. 79; and *Introd. to Modern Classific. of Insects*, vol. i. p. 4.]

ARTICULATED ANIMALS, FURNISHED WITH ARTICULATED FEET,* IN GENERAL.

CRUSTACEA, ARACHNIDA, AND INSECTA.

These three† classes, united together by Linnæus under the common name of Insects, but which I name Condylopa, are distinguished by their articulated feet, of which they have at least six.‡ Each joint [of the legs] is tubular, and contains the muscles of the following articulation, which always moves by ginglymus,—that is, in but one direction. The first joint which attaches the limb to the body, and which is generally composed of two§ pieces, is named the coxa, or hip, [the second of these pieces, when present, is termed the trochanter]; the next piece, which is ordinarily in a position nearly horizontal, is the femur, or thigh; the third is generally vertical, and is named the tibia, or shank; and the terminal part of the leg, or properly the foot, is composed of a series of small joints, which touch the ground, and which are collectively named the tarsus.

The hardness of the calcareous or horny ‖ envelope of the majority of these animals is owing to that of the excretion which is interposed between the dermis and epidermis, or what is termed in Man the mucous tissue. It is also in this excretion that are lodged the often brilliant and varying colours with which these animals are sometimes adorned.

These creatures are always furnished with eyes. These are of two kinds:—1st, The simple eyes, named ocelli, or stemmata, ordinarily resembling a minute lens, and of which there are generally three, arranged in a triangle on the crown of the head; and, 2ndly, the facetted or composite eyes, of which the surface is divided into an infinite number of

* The series of [external] articulations of which the body is composed has been compared to a skeleton, or vertebral column; but this is erroneous, because the supposed vertebræ are only hardened portions of the skin, connected by more slender membranous intervening portions. The researches of Strauss especially prove this, in opposition to Robineau Desvoidy, and others. The power of exuviation especially distinguishes these from other Invertebrata.

† Dr. Leach formed the Myriapoda into a distinct class. The trachean Arachnida might also, from their anatomical characters, constitute another, but they are too nearly allied to the pulmonary Arachnida to allow this separation.

‡ Hexapods. Those with more than six feet are the Apiropoda of Savigny, or my Hyperhexapods.

§ In many Crustacea, the second piece of the coxa appears to form part of the femur, and the tibiæ (as also in the Arachnida) are two-jointed.

‖ According to M. Odier, the chief substance of which this integument is composed is of a peculiar nature, which he names chitine. Phosphate of lime forms the chief part of the salts of the teguments of *insects*, whilst the carapax of the *crabs* abounds in carbonate of lime.

minute [hexagonal] lenses or facets, to each of which there is a corresponding filament of the optic nerve. These two kinds of eyes may exist in conjunction or separately, varying in the genera; and we know not whether their action, when united in the same individual, be essentially different. The sense of sight, however, must in all instances be effected in a manner quite unlike that of the Vertebrata. (Consult the Memoir of Serres on the Eyes of Insects, Montpelier, 1815, 1 vol. 8vo; and the Observations of Blainville on the Eyes of *Crustacea*, in *Bull. Soc. Philomat.*) [also the memoir of J. Müller, conscisely abstracted in the " Insect Miscellanies."]

Other organs, which we here find, for the first time, amongst the Crustacea and Insecta*, and which are named antennæ, are articulated filaments, varied in the greatest degree as to their form, even in the sexes of the same species, arising from the head, and appearing eminently endued with a delicate sense of touch, and perhaps, also, with some other kind of sensation of which we have no idea, but which has reference to the state of the atmosphere.

These animals also enjoy the senses of smell and hearing. Some authors place the seat of the first of these senses in the antennæ†; others, as M. Dumeril, in the orifices of the breathing pores; and others, as M. de Serres, in the palpi. These opinions, however, are not founded upon positive and conclusive facts. As to the sense of hearing, the Decapod Crustacea, and certain Orthoptera, alone possess a visible ear.

The mouth of these animals presents a great analogy [or general uniformity], which also extends, according to Savigny‡, in a relative manner, even to those species which subsist by suction. Those which gnaw their food [*Mandibulata*, Clairville] by means of jaws fit for trituration, have the parts of the mouth arranged in pairs laterally, and placed one before [or over] the other. The anterior pair are specially named mandibles, [the succeeding pair or pairs being termed maxillæ, or hind jaws]; the pieces which cover the jaws before and behind are the lips§, that in front being called the labrum, [and that behind being the labium]. The palpi are articulated filaments attached to the hind jaws and the hind or lower lip, and appear to assist the animal in recognizing its food. The form of these different organs determine [or, more properly speaking, indicate] the kind of nourishment with as much precision as the dental system of Mammalia. Within the lower lip‖, the tongue (ligula) [or rather lingua] is ordinarily attached. Sometimes, as in the bees, and many other Hymenoptera, it is prolonged considerably, as well as the maxillæ, forming a kind of proboscis (promuscis), with the pharynx at its base often covered by a kind of secondary lip (*sous-labre; epipharynx*, Savigny), and which appears to me to exist, in many beetles, in the form

* And even in the Arachnida, but under modified forms, and with modified functions.

† *With reference, at least, to Insecta, and when they terminate in* a more or less complicated mass, or are clothed with a great quantity of hairs. According to M. Desvoidy, the internal antennæ of the Decapod Crustacea are organs of smell (*Bull. Sci. Nat.* 1827), but he cites no direct proof; and, indeed, in the most carnivorous crabs (*Gecarcinus*, &c.), where the organ of smell ought to be most fully developed, the very reverse takes place, [the inner antennæ being very small.]

‡ *Mémoires sur les Animaux sans Vertèbres.* The original idea [of this uniformity] was first announced by me (but without developement) in my *Histoire Générale des Insectes.*

§ I here more particularly allude to the Hexapod insects.

‖ The labium is protected in front by a corneous piece, formed by a cutaneous elongation, and articulated at its base with a part of the under side of the head, named the mentum. Its two palpi are termed labial palpi. The maxillary palpi are two or four in number, in the latter case being named external and internal, the internal palpi being a modification of the outer lobe of the maxillæ, and which is named galea by Fabricius, in Orthopterous insects. In these insects, and in the Libellulæ, there is a soft vesiculose body in the middle of the *mouth, distinct from the lower lip, and which, compared with the* Crustacea, appears to be the true tongue (*Labium*, Fabr.) This organ is probably represented in many Coleoptera by the lateral divisions *of the labium, which are termed paraglossæ. The membranous* terminal part of the lower lip, extending between the palpi in the Orthoptera and Libellulæ, is quite distinct from this central tongue, although nearly all entomologists have termed this terminal extremity of the lip by the name of languette. It is, nevertheless, true, that this central tongue is often closely soldered to the [inner surface of] the lower lip. [The composition of the lower lip is very complicated, and variable in different groups. As a whole, it is best to retain for it the name of labium. Its corneous basal piece is the mentum. The following piece is generally called the labium, having the labial palpi arising at its base; but the German authors term this terminal piece ligula. The internal piece is the lingua. Latreille refers to the larvæ of the Dyticidæ, as affording a clear notion of the typical structure of the labium; but in these larvæ, the labium is almost obsolete The perfect Silphæ, or Staphylini, afford much better instances.]

of a membranous piece beneath the labrum, which has the same reference to it as the mentum has to the labium.

In Hemiptera and Diptera the mandibles and maxillæ are represented by scaly pieces, in the form of setæ or lancets, received in a tubular elongated sheath, which is either cylindrical and articulated, or elbowed, and terminated by fleshy lip-like pieces. In these insects the mouth becomes a real sucker. In other suctorial insects (Lepidoptera) the maxillæ alone are elongated, conjointly forming a tubular and very slender instrument like a long tongue, spirally folded up at rest, the other parts of the mouth being but very slightly developed, [except the labial palpi]. Sometimes, as in many Crustacea, the fore-legs approach the maxillæ, taking their form and exercising their functions, so that the maxillæ may in such cases be said to be multiplied, and sometimes it may even occur that the real maxillæ are so much reduced in size that the maxillary feet or foot-jaws (*pieds-machoires*) entirely replace them. But, whatever may be the modifications of these parts, they may always be recognized, and these variations reduced to a primitive or general type. [This kind of reasoning may appear fanciful to persons who have not studied the comparative anatomy of these lower animals, but there are so many instances in which feet are transformed into jaws, and jaws into feet, that it is impossible not to arrive at the conclusion that these organs are but modifications of each other. For instance, in the crabs there are three pairs of foot-jaws and five pairs of legs, whilst in the jumping shrimps (Amphipoda) there is only one pair of foot-jaws, the number of legs being increased to seven pairs by the addition of the two outer pair of foot-jaws. The genera Sergestes, Sicyonia, and Acetes amongst the Shrimps still more clearly prove this, for here the typical number of legs is five pairs, but the same kind of modifications occur. In the winged insects it is quite sufficient to examine the lower lip of a grasshopper, cockroach, or white ant, to perceive at once that it consists of a pair of small maxillæ soldered together, the ligula (or labium, as it is restrictedly called by some authors) consisting of two inner lobes, and two galeæ, with two labial palpi: if, therefore, we consider the internal lobe of the maxillæ as a palpus, the labium in these insects will possess four palpi and two inner lobes. If we adopt this principle, we must suppose that as each leg-bearing segment is furnished with a pair of limbs, the head is a compound segment, furnished with several pairs of limbs, being the analogues of legs, and such is the view entertained by some of the most celebrated of modern entomologists. The same principle Latreille considers to be equally applicable to the antennæ, or at least to the inner pair of these organs in the Crustacea, and hence the Arachnida and Myriapoda are not, in this respect, anomalous exceptions to the principle.]

THE FIRST CLASS OF ARTICULATED ANIMALS WITH ARTICULATED LEGS.

CRUSTACEA.

The Crustacea are articulated animals, provided with articulated legs, respiring by branchiæ (a kind of gills), covered in some species by the sides of the carapax or shell, and external in others; but which are not inclosed in particular cavities of the body, receiving the air by means of orifices in the surface of the skin. Their circulation is

double, and analogous to that of the Mollusca. The blood is transmitted from the heart, situated near the back, to the different parts of the body, where it is conveyed to the branchiæ, and thence back to the heart. These branchiæ are situated either at the base of the legs or upon the legs themselves, or upon the subabdominal appendages, forming either pyramidal masses, composed of layers of fine plates or clothed with setæ, or consisting of simple plates in tufts, even in some appearing to consist only of hairs.

The nervous system of the Crustacea (especially investigated by Cuvier, Audouin, and Milne Edwards), exhibits two very different appearances, constituting the two extremes of the modifications it presents in this class. Sometimes, as in the leaping shrimps (*Talitrus*), it is composed of two nervous chords, with knots or ganglions at equal distances along the whole length of the body, and sometimes, as in the Crab (*Maia Squinado*), it consists of only two nervous masses, of unequal size, one placed in the head and the other in the thorax. Other Crustacea (*Cymothoa*, *Phyllosoma*, *Palinurus*, *Palemon*, and *Astacus*), exhibit intermediate formations, showing the gradual modifications.*

The Crustacea are destitute of wings, provided with two facetted eyes, but rarely with simple eyes, and generally with four antennæ. They have in general (the Pœcilopoda excepted) three pairs of maxillæ (the upper pair or true mandibles included), the same number of foot-jaws, the outer pairs of which become, in many species, real feet; and ten legs, all of which are terminated by a single hook. When the two outer pairs of foot-jaws perform the office of feet, the number of legs is [increased to] fourteen. The mouth consists, as in insects, of an upper lip, a tongue, but no true lower lip comparable with that of insects, the external pair of foot-jaws [the third pair, or, where the two outer pairs become legs, the first pair] closing the mouth and acting instead of a lip, [thus proving what has been suggested above relative to the nature of the labium in insects].

Their envelope is generally solid, and more or less calcareous. They change their coats several times, generally retaining their primitive form† and their natural activity. They are in general carnivorous, aquatic, and their life extends through several years. They do not become adults until after a series of moultings. With the exception of a small number in which these moultings somewhat modify the primitive form, and augment the number of locomotive organs, these animals are at their birth (size excepted) such as they will remain throughout their life.

The situation and the form of the branchiæ, the manner in which the head is articulated with the trunk or thorax, the moveable or fixed structure of the eyes‡, the organs of mastication, and the tegumentary system, form the bases of our distribution, and give rise to the following orders in the class, and which are confirmed by the observations hitherto made upon the nervous system.

* [The modifications in the structure of the nervous system of the larva, pupa, and imago of the same insect, fully confirm this, that of the larva resembling that of the Talitrus, whilst that of the imago is more analogous to that of the Crab. If we regard the larva as in a state of immaturity or imperfection, we should be led to consider the Crab as far higher in the chain of nature than the Talitrus, and such *is the station generally assigned to it, without reference to its nervous* system.]

† [*This statement has been opposed by Dr. J. V. Thompson, in his* Zoological Researches and other more recent articles, this writer asserting that the Crustacea undergo a series of transformations as striking as those of the true insects; the anomalous animals long known under the generic name of Zoea, and which have long perplexed Crustaceologists (for want o. a perfect investigation of their structure), being affirmed by him to be the young of the Crabs and other Decapoda. In some cases, however, where a minute analysis of the eggs of different species has been made, a contrary result has been obtained, Rathke having dissected the eggs and watched the gradual developement of the embryo of the crayfish, and I having dissected the eggs of the land crab of the West Indies, the young in both instances (and in others subsequently observed by Rathke) resembling *the parents in general appearance.*]

‡ Whence Lamarck divided the Crustacea into the Pediocles (or eyes on footstalks) and Sessiliocles (or sessile eyes). Leach changed these names (applying them only to the Malacostraca) into Podopthalma and Edriopthalma. Gronovius first employed this character.

We divide the class into two sections, Malacostraca and Entomostraca.*

The MALACOSTRACA have the envelope ordinarily very solid, of a calcareous nature, and ten or fourteen† legs, hooked at the tip; the mouth placed in the ordinary situation, and composed of a labrum, a lingua, a tongue, two mandibles, often palpigerous‡, two pairs of maxillæ covered by the foot-jaws. In a great number each of the eyes is supported upon a moveable footstalk, articulated [at its base], and the branchiæ are hidden beneath the lateral margins of the carapax or shell; in others, however, they are attached beneath the post-abdomen.

The Malacostraca consist of five orders:—1. *Decapoda*; 2. *Stomapoda*; 3. *Læmodipoda*; 4. *Amphipoda*; 5. *Isopoda*. The first four of these orders were included in the Linnæan genus *Cancer*, and the last in his genus *Oniscus*.

The ENTOMOSTRACA, or shell insects (*insectes à coquille*) of Muller, are composed of the genus Monoculus of Linnæus. The envelope is corneous, very slender, and the body in the majority is covered by a shell, composed of two pieces, not unlike that of the bivalve Mollusca. The eyes are ordinarily sessile, and often there is but one of these organs. The legs, of which the number varies, are, in the majority, fitted only for swimming, without any terminal hook. Some of them are most nearly allied to the preceding groups by having the mouth anteriorly situated, and composed of a labrum, two mandibles (rarely palpigerous), a tongue, and at most two pair of maxillæ, the outer ones not being covered by foot-jaws. In the others, which appear to approach the Arachnida in many respects, the organs of mastication sometimes merely consist of the coxæ of the legs advanced and lobe-like, armed with numerous small spines, and surrounding a large central pharynx: whilst in others they form a small siphon or beak, used as a sucker, as in many Arachnida and Insects; and even sometimes they are not, or scarcely, visible on the exterior of the body, the siphon itself being either internal, or the action of suction being performed by a kind of sucking cup (*ventouse*).

Hence the Entomostraca are either dentate or edentate. The dentate species compose one order, Branchiopoda, and the edentate that of Pœcilopoda§, which, in the first edition of this book, I had considered as a section of the preceding order.

* Jurine divided the class into two sections, founded upon the presence or want of jaws, in his Memoir on Argulus. [Latreille also adopted this as a primary character in his *Cours d'Entomologie*.]

† The four anterior, when there are fourteen, are formed of the four posterior foot-jaws. In the Decapoda the six foot-jaws are applied to the mouth, and serve as under jaws.

‡ [This peculiarity never occurs in the true insects, and serves to prove that the mandibles are but modified maxillæ, or rather, to speak more theoretically, the inferior appendages of one of the articulations of the body.]

§ In my *Familles Naturelles du Règne Animal*, the Entomostraca were divided into four orders, namely, Lophyropoda, Phyllopoda, Xiphosura, and Siphonostoma. [The Entomostracous Crustacea, like the Invertebrata, having been proved by recent investigators to consist of several tribes of animals much more strongly modified in their structure than the Malacostraca, it has become necessary to establish a *greater number of orders and primary groups for their reception* than were proposed in this work, and Latreille himself became aware of the necessity for such a step, having considerably altered the arrangement of the class in his *Cours d'Entomologie* subsequently published. Milne Edwards, Burmeister, and De Haan have especially investigated these animals during the last ten years, and it will be serviceable to give a short abstract of the arrangements which they have proposed, especially as the works of the two last-named authors are in the hands of so few naturalists, that even Milne Edwards has not mentioned them in his Review of Crustaceology (*Suites de Buffon*). Latreille himself, in his *Cours d'Entomologie*, had cut up the Entomostraca (which he had sunk as a primary section of the class in favour of sections characterized by the mouth organs) into five orders, Lophyropoda, Ostrapoda, Phyllopoda, Xiphosura, and Siphonostoma, and had characterized several sub-orders which Edwards subsequently adopted in the following sketch (*Suites de Buffon*, Crust. I. p. 236, modified from that published in the *Annales des Sci. Nat.*, March, 1830).

Subclass I.—Crustacea with maxillæ.
Legion 1. Podopthalma.
Order 1. Decapoda.
2. Stomapoda.
Legion 2. Edriopthalma.
Order 3. Amphipoda.
Order 4. Isopoda. Order 5. Læmipoda.
Legion 2. Branchiopoda. Legion 3. Entomostraca.
Order 6. Ostrapoda (Cythere). Order 8. Copepoda (Cyclops).
7. Phyllopoda. 9. Cladocera (Daphnia, &c.)
Legion 4. Trilobita.
Subclass II.—Crustacea with a sucker.
Legion 1. Ambulatory Parasites.
Order 10. Araneiformes (Pycnogonum).
Legion 2. Swimming Parasites.
Order 11. Siphonostoma.
12. Lerneæ.
Subclass III.—Crustacea Xiphosura.
Order 13. Xiphosura.

Burmeister, in his *Grundriss fur Naturgeschichte*, *Zoologischer Handatlas*, and Memoir on the Cirripedes, has divided the class into three orders only:—

The singular fossils called Trilobites, of which M. Brongniart has furnished an excellent monograph, being considered by him and many other naturalists as crustaceous animals allied to the Entomostraca, we have introduced them concisely at the end of that section.

FIRST GENERAL DIVISION.

CRUSTACEA MALACOSTRACA,—

Which are divisible into those which have the eyes placed on a moveable foot-stalk, and those which have them sessile and fixed.

Those MALACOSTRACA with the eyes placed on a moveable foot-stalk, articulated [at the base, PODOPTHALMA, Leach], composing the orders Decapoda and Stomapoda, have many characters in common. A large shield, sometimes divided into two parts, and termed the shell or carapax, covers a large portion of the front of the body. They have four antennæ, the exterior pair being longest and simple, whilst the intermediate pair is shorter, and divided at the tip into two branches in the crabs, and into three in many of the Macrura; two mandibles, each with a three-jointed palpus near the base, a bilobed tongue, two pairs of maxillæ, three pairs of foot-jaws, the two outer pairs being in some [Squilla] transformed into claws, and ten or fourteen (in those species which have the four outer foot-jaws leg-shaped) legs.

In the majority the branchiæ, of which there are seven pairs, are hidden beneath the lateral margins of the carapax, the two anterior pairs being fixed at the base of the two exterior pairs of foot-jaws, and the others at the base of the true legs. In the other species [Squilla, &c.] they form brushes attached to the five pairs of sub-abdominal swimming legs. The under side of this post-abdomen is likewise furnished in the others with four or five pairs of bifid appendages.

THE FIRST ORDER OF CRUSTACEA.

DECAPODA (TEN-FOOTED).

The head is compactly soldered to the thorax, and covered, as well as that part of the body, by a large and continuous shell or carapax, generally exhibiting on its surface various impressed lines, dividing it into regions corresponding with the internal organs, and which have been ingeniously named by M. Desmarest. The circulatory system differs in some respects from that of the other Crustacea; the blood before reaching the branchiæ to be oxygenated passing through two great reservoirs, one on each side, above the legs, analogous to the lateral hearts of the Cephalopods, according to Milne Edwards, Audouin, and Cuvier.

1. Aspidostraca, divided into five sub-orders.
   1. Parasita, including the Penellina, Lernæoda, Ergasilina, Caligina, and Argulina.
   2. Lophyropoda, including the Ostracoda, Cladocera, and Cyclopida.
   3. Phyllopoda, including the Gymnota (Branchipus), and Aspidophora (*Apus*).
   4. Cirripedia, including the Lepadea and Balanoda.
   5. Pœcilopoda, including only Xiphosura.
2. Thoracostraca (*Podopthalma*, Leach), divided into two suborders, Decapoda and Stomapoda.
3. Arthrostraca (*Edriopthalma*, Leach), divided into nine minor divisions, Gammarina, Typhina, Lœmodipoda, Epicarida, Cymothoadæ, Sphœromatoda, Asellina, Idotoda, and Oniscoda.

De Haan, *in his magnificent work upon the Crustacea of Japan*, adopting the quinarian circular system of M'Leay, divides the class into five orders,—*Decapoda*, Stomapoda, Tetradecapoda (*Edriopthalma*, Leach), Lophyropoda, and Phyllopoda. M. Duverney has, within the last few months, submitted a Memoir to the Académie des Sciences at Paris, proposing a new classification of the Crustacea according to the organs of respiration, dividing the class into three principal groups, Nudibranchiæ, Cryptobranchiæ, and Lamellibranchiæ; but the adoption of this, like any other single character, has had the effect of *breaking the most natural relations*.

The lateral edges of the carapax are bent downwards in order to cover and defend the branchiæ, an aperture being left in front of the shell for the passage of the water.* The branchiæ are situated at the base of the four exterior foot-jaws and of the legs, the four anterior being smallest. The six foot-jaws are of a different form, applied to the mouth and divided into two branches, the exterior resembling a small antenna, furnished at the tip with a short multiarticulate piece [and the interior composed of several joints, the two basal being greatly dilated in the crabs], the base being also furnished with a long pilose tendinous branch. The anterior pair of legs, and sometimes the two or four following, form large claws, the penultimate joint being dilated, with its lower extremity prolonged into a finger opposed to the terminal joints or true tragus, which is moveable, and is named the pollex, whilst the other is fixed, and is named the index. In Squilla the last joint is very short, and then the penultimate joint folds back upon the preceding. The antepenultimate joint is the carpus. The respective proportions and situation of their limbs is such that these creatures are able to walk sideways or backwards [crab-like].

The majority of the viscera are inclosed in the thorax, which thus represents the thorax and greater part of the abdomen of the insects; the terminal articulated parts of the body immediately following those segments to which the five pairs of true legs are attached, constitute the part which I name the post-abdomen. The stomach is armed within with five bony and dentated pieces which serve to triturate the food. At the time of moulting, two calcareous bodies, round on one side and flat on the other, are found in the stomach, which are ordinarily called crabs-eyes, and which, as they disappear after moulting, have been considered to furnish the material for the renewal of the carapax.

The growth of these animals is slow, and they live for a long time. It is amongst these animals that we find the largest species of annulosa, as well as the most useful as articles of food; their flesh is, however, hard of digestion. The body of some species of Palinurus is more than a foot in length. Their claws, as is well known, are extremely powerful. They *ordinarily reside in the water, but are not immediately killed by being removed into the air:* indeed, some species pass a considerable part of their existence out of the water, which they only seek in order to deposit their eggs in it. They are, nevertheless, compelled to reside in damp situations and burrows. They are naturally voracious and carnivorous: some species, indeed, are said to frequent the cemeteries in order to feed upon dead bodies. Their limbs are renewed [when injured] with great quickness, but it is necessary that the fracture should have been made at the junction of the joints: they, however, have the instinct to effect this if the wound has been of a different nature. When desirous to change their skins, they seek for some retired spot, where they may be at rest and secure from their enemies. The moulting then takes place, the body being at first soft and of a delicate flavour, [as in the case of the black crab of the West Indies, which is kept in cages expressly for the table]. The chemical analysis of the old shell proves that it is formed of carbonate of lime and phosphate of lime in different proportions. By the action of the heat the epidermis assumes a bright red colour, the colouring principle being decomposed by the action of boiling water.

The greater number of fossil Crustacea hitherto discovered belong to the order of Decapoda. Amongst the European fossil species, the most ancient approach nearest to the existing species found in tropical seas, while the more modern ones have a greater resemblance to the species now existing in our own climates. The fossil Crustacea of tropical regions bear a greater relation to the existing species found in the same situations — a fact of considerable geological interest. [The order contains two families, or rather sub-orders, named, from the comparative size of the tail, Brachyura (short tailed) and Macroura or Macrura (long tailed.)†]

* MM. Audouin and Milne Edwards have communicated to the Academie des Sciences some interesting observations upon a peculiar organ which exists in the Land Crabs, forming a kind of reservoir, placed immediately above the branchiæ, and capable of containing a certain quantity of water [serving of course for the oxygenation of the blood during a considerable period]. It is on this account that these crabs have the sides of the thorax more gibbose than ordinary.

† [M. Edwards proposed the establishment of a third sub-order under the name of Anomoura, forming a passage between the two other groups, and composed of species belonging strictly to neither, which

THE FIRST FAMILY* OF DECAPODA,—

DECAPODA BRACHYURA (*Kleistagnatha*, Fabricius),—

Has the tail (or post-abdomen) shorter than the thorax, without appendages or swimmerets at its extremity, and in a state of rest folded beneath the breast, and lodged in a sternal cavity. It is triangular in the males, but rounded and swollen in the females†, and is furnished in the former with four or two appendages at the base [on the inside], whilst in the female it has four pair of double filaments employed in carrying the eggs, and which are analogous to the swimming sub-abdominal appendages of the Macrura. The *antennæ* are small; the intermediate pair, generally lodged in a cavity beneath the fore-margin of the carapax, are terminated by two very short [articulated] filaments. The peduncles of the eyes are larger than in the Macrura. The first pair of legs is terminated by a claw. The branchiæ are arranged in a single row in the form of pyramidal plates, composed of a great number of minute leaflets spread one upon the other: the foot-jaws are ordinarily shorter and broader than in the Decapods, the outer pair forming a kind of labium.

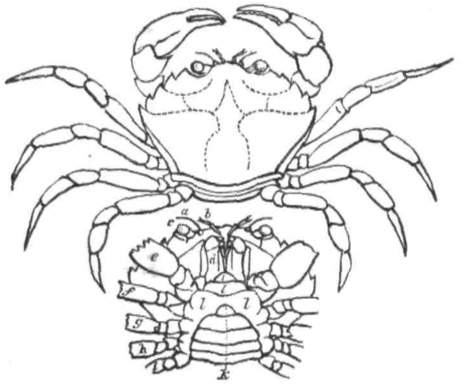

Fig. 1.—*Carcinus Mænas* (Common small Edible Crab), upper side and under side of the body, with the limbs truncated.—*a*, lateral antenna; *b*, intermediate antenna; *c*, eye; *d*, outer foot jaw; *e, f, g, h*, base of the five pairs of legs; *k*, tail; *l*, sternum.

This family may be regarded as constituting the single genus

CANCER,—

Comprising the numerous species of crabs [and consisting of a portion only of the Linnæan genus Cancer, divisible into seven sections and a great number of minor divisions, regarded by recent authors as genera]. Of these the majority have the legs attached at the sides of the breast, and always exposed. The species thus characterized constitute the first five sections, Pinnipedes, Arcuata, Quadrilatera, Orbiculata, and Trigona.‡

had long perplexed Crustaceologists; and M'Leay, in order to adopt his quinarian system to these animals, has divided the Decapoda into five tribes, Tetragonostoma and Trigonostoma (composing the Brachyura), and Anomura, Sarobranchia, and Caridea (composing the Macroura).—*Illustr. Annulos. of South Africa*, No. 3.]

* The groups thus indicated are founded upon a general survey of important anatomical characters, and generally correspond with the Linnæan genera, *and sometimes also to those of the earlier works* of Fabricius. These families are here of greater extent than in my other writings; but if we regard these as primary ordinal divisions, and the groups here called tribes as families, the arrangement will be *found essentially identical. In the same manner the subgenera here* indicated ought, in a more detailed arrangement, to be regarded as genera, and thus, although the Decapoda are here only divided into two genera, it would be correct, in order to bring the system to the level of our present knowledge, and in order to diminish the vast number of sub-genera, to convert the sections into tribes or genera, which might then be divided into subgenera.

† The apparent number of segments is generally seven, varying occasionally in the sexes of the same species, in which case the females have the least number. Dr. Leach made great use of this character, but it appears to me to be too unimportant.

‡ [Latreille regarded this arrangement of the Crabs here given as artificial in many respects, and he had modified it not only in his *Familles Naturelles, in which the tribes here given were introduced* but their relative position altered, but in his subsequent *Cours d'Entomologie* he proposed another arrangement of the order, as follows:—

Section 1. Homocheles, claws of equal size in both sexes.

Division 1. All the feet attached to the body in the same line.

Tribes.—1. Quadrilatera, 2. Arcuata, 3. Pinnipedes, 4. Christimani, 5. Cryptopoda.

Division 2. With the two or four posterior legs dorsal.

Tribe.—6. Notopoda.

Section 2. Heterocheles, claws of the males larger than those of the females.

Division 1. *All the legs in the same line.*

Tribes.—7. Orbiculata, 8. Trigona.

Division 2. Hind pairs of legs very small, and either dorsal or abortive.

Tribe.—9. Hypopthalma.

Dr. Leach, as above mentioned, adopted the number of abdominal segments, and was *consequently led to distribute this order into still* more numerous families. Milne Edwards, however, in his *Hist. Nat. des Crustacés*, now in course of publication, has, from anatomical considerations, considered it more natural to separate the Brachyura into only four great families.

1. The Oxyrhycha (Trigona, Latr. or the families Maiadæ, Lithodiadæ, and Macropodiadæ of Leach), consisting of the sea spiders or thorn-backed crabs, the legs being long, the carapax narrowed into a point in front, the epistoma very large and nearly square. (Three tribes, Macropodiens, Maiens, and Parthenopiens).
2. The Cyclometopa (or the Canceridæ, Portunidæ, and Pilumnidæ of Leach): carapax very large, arched in front, narrowed behind, legs moderately long, epistoma very short, transverse. (Two tribes, 1. *Canceriens, composed of three sub-tribes, Cryptopoda, Arcuata,* and Quadrilatera; and, 2. Portuniens or Pinnipedes).
3. The Catametopa (Ocypodiadæ, Leach), having the carapax quadrilateral or ovoid, the front transverse and knotted, epistoma very short.
4. The Oxystoma (Corystidæ and Leucosiadæ, Leach), with the shell orbicular and arched in front, which is not pointed, epistoma obsolete.

The first section, PINNIPEDES, have the hind pair of legs terminated by a flattened plate for swimming, and these species are accordingly met with at a distance from the coasts.

Amongst these swimming or shuttle-crabs, as they are termed, are especially to be noticed the exotic species, composing the genus *Matuta*, Fab., having the carapax nearly circular, and armed on each side with a strong spine, and with the four posterior pairs of legs terminated by a dilated plate for swimming. The same is also the case, but less strongly, in Leach's genus *Polybius*, consisting of the single species, *P. Henslowii*, found on the Devonshire coast. Amongst the species with only the last pair of legs dilated at the extremity into a plate for swimming, the genus *Orithyia*, Fabr., consisting of a single Chinese species, is distinguished by the tail of the males being distinctly seven-jointed, whereas there are only five joints in the males of all the other Pinnipedes, the females alone having seven joints. Amongst these the genus *Podopthalmus*, Lamarck, has the carapax transverse, and armed at each side with a very long spine; the ocular peduncles are very long (*P. spinosus*, Latr., Isle of France); others which have the ocular peduncles short, and which are of the ordinary crab-like form, compose the genus *Portunus*, Fab., amongst which may be mentioned *Cancer pu'er*, Linn., and *Cancer Mœnas*, Linn. (*Carcinus Mœnas*, Leach), two small species, commonly used as articles of food by the lower orders in London. The last-named species is exceedingly abundant; the terminal joint of the hind legs is much narrower than in the preceding groups, and thus this species forms a passage to—

The second section, ARCUATA, in which the tarsus, or last joint of all the legs, is conical, and sometimes compressed, but never forming a swimming plate, and the carapax arched in front and narrowed behind, with the claws of equal size in both sexes, and the tail is composed of the same number of segments as in the Portuni. The true Crabs, composing the restricted genus *Cancer*, Fabr., are the types of this section, and are distinguished by having the third joint of the outer foot-jaws emarginate or sinuated near the inner extremity, and nearly square. The antennæ scarcely extend beyond the front, with but few joints, and are folded backwards.

Cancer pagurus, Linn., the common large edible crab, has the carapax very broad, and arched for a great distance along the sides, each side having nine festoons, and the middle in front with three short teeth: the claws are large, and the fingers black and armed with obtuse points. It sometimes reaches nearly a foot in breadth, and is of common occurrence on the coasts of England and France. [It is captured by sinking pots, baskets, or nets, baited with decaying animal matter, to a considerable depth in the ocean, along the rocky coast. During the summer months it is very abundant, especially where the water is deep; and at low tide they are found in holes of rocks in pairs, male and female, and if the male be taken away another will be found in the hole at the next recess of the tide. By knowing this fact, an experienced fisherman may twice a day take with little work a vast number of specimens, after having discovered their haunts. In the winter they are supposed to burrow in the sand, or to retire to the deeper parts of the ocean. (Ent. Compend. p. 86.) Mr. Bell has described some beautiful exotic species of this genus in the Transactions of the Zoological Society, vol. i.] The genus *Xantho*, Leach, is nearly allied to the preceding, but having the external antennæ short, and inserted in the external canthus of the eye. The typical species, *X. florida*, Leach, inhabits our coasts.

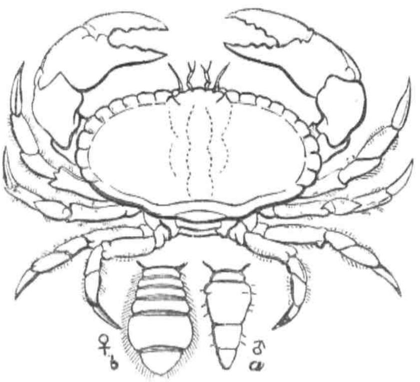

Fig. 2.—*Cancer Pagurus*, Linn., with the tail of the male, *a*; and of the female, *b*.

The genus *Perimela*, Leach, has a longer carapax, with the edges strongly toothed, the eight hind legs equally compressed, and longer antennæ. *P. denticulata*, Leach, occurs in various parts of our coast, and in the Mediterranean.

The genus *Atelecyclus*, Leach, has the carapax nearly rounded, and dentated at the sides, the tail narrower than in the preceding; the lateral antennæ elongated, the claws very strong, and rather short. The type of this genus is the *Cancer 7-dentatus* of Montague, by whom it was discovered on the coast of Devonshire. Other genera, which it would occupy too much space to notice, have been separated by Leach, Latreille, and others. Amongst them, however, the two exotic genera, *Mursea*, Leach, and *Hepatus*, Lat., are distinguished by their claws being greatly compressed, so that they have subsequently been separated by Latreille, as a section thence named Cristimani, or crested-handed Crabs.

Mr. M'Leay's arrangement of the Brachyura, as given in the 3rd part of the *Illustrations of the Zoology of Southern Africa*, just published, is as follows:—

Tribe Tetragonostoma.	Analogies.	Tribe Trigonostoma.
Pinnotherina (Parasit. Crabs)	Shell orbicular	Dromiina.
Grapsina (Square Crabs)	Shell quadrilateral	Dorippina.
Caucrina (Arched Crabs)	Shell arcuated, with the feet often natatory	Coystrina.
Parthenopina (Rocky Crabs)	Shell uneven, with crested feet	Calappina.
Inachina (Triangular Crabs)	Shell subtriangular, and genera .y spined	Leucosina.

The third section, QUADRILATERA, have the carapax nearly square, or heart-shaped, with the front generally elongated and deflexed, forming a kind of hood. The tail is composed of seven segments in both sexes, the joints being distinct throughout the entire breadth of the tail. The antennæ are generally very short. The eyes are generally placed upon long peduncles. Many species reside in the ground, forming burrows for their retreats, and some frequent fresh water. They are able to run very fast. Some of these species have the carapax somewhat heart-shaped [thus nearly resembling some of the *Arcuata*], with the front margin strongly toothed, including the genera *Eriphia*, Lat., *Trapezia*, Lat., and *Pilumnus*, Leach, in which last the claws are of unequal size.

The Thelphusæ, Lat., have the lateral antennæ shorter than the ocular peduncles, and few-jointed. The carapax is nearly of a cordate truncate form, [but broader behind than in the preceding]. There are several species of this genus, which reside in fresh water, but being able to exist for a considerable time out of their native element; one noticed by the ancients occurs in the south of Europe; it is the *Cancer fluviatilis*, Belon. It is often represented upon the ancient Greek medals. The Greek monks eat it uncooked, and it forms a common article of food in Italy during Lent. Delalande and De Latour discovered two other species, one in the south of Africa and the other in the mountains of Ceylon. [I have described and figured another species, under the name of *Thelphusa cunicularis*, discovered by Col. Sykes, in the ghauts of the Deccan, where it occurs in great abundance, and of which Bishop Heber thus speaks in his Journal:—" All the grass through the Deccan generally swarms with a small land-crab, which burrows in the ground, and runs with considerable swiftness, even when encumbered with a bundle of food as big as itself; this food is grass, or the green stalks of rice, and it is amusing to see the crab sitting, as it were, upright to cut their hay with their sharp pincers, and then waddling off with their sheaf to their holes, as quickly as their side-long pace will carry them." Col. Sykes found them on the table lands at an elevation of nearly 4000 feet above the sea, and as they are met with of all sizes, he believes that there productive process is completed without the Crab having to undertake any annual journey to the sea, their migrations having never been noticed.—*Trans. Ent. Soc.*, vol. i.] To this section also belong other species of Land Crabs, composing the genera *Gelasimus*, *Ocypoda*, and *Mictyris*. The first of these genera has the carapax solid, and nearly quadrilateral, but rather broader in front; one of the claws is generally much longer than the other, the fingers of the smaller claws being spoon-shaped. The animal closes the mouth of its burrow, which it makes near the shore, with its larger claw. These burrows are cylindrical, oblique, and very deep, each having a single inhabitant. It is the habit of this Crab to hold up the large claw in the front of the body, as though beckoning to some one, whence they have obtained the name of Calling Crabs. The species of *Ocypoda* has the eyes extended along the greater length of the foot-stalks. Their claws are also unequal, but not to the same extent as in the *Gelasimi*. During the day they sit in their burrows, venturing forth only after sun-set. The type *Cancer cursor*, Linn., inhabits Syria and Northern Africa. Other species of Land Crabs are of a truncate cordate form, with the shell rounded and dilated at the sides. They inhabit tropical climates, and are called by the inhabitants tourlouroux, painted Crabs, land Crabs, violet Crabs, &c., which names seem to be applied indiscriminately. There are few travellers who have not mentioned their habits, often mixing up much fiction in their accounts. They pass the greater part of their lives in the earth, hiding themselves by day and coming abroad only at night. Sometimes they frequent cemeteries. Once a year, as the period for depositing their eggs draws near, they assemble in numerous companies, and following the most direct line, seek the coast without permitting any obstacle to intercept them in their way; after laying their eggs [in the water] they return, greatly enfeebled. It is said that they close the mouth of their burrows at the period of moulting, after which operation, and whilst still soft, they are reckoned a great delicacy. These species compose the genera *Uca*, Latreille, (type *Cancer uca*, Linn., South America), and *Gecarcinus*, Leach, (*Cancer ruricola*, Cuv., &c.)

Another interesting group constitutes the genus *Pinnotheres*, Latr. These are of very small size [of which there are several native species, named pea-crabs], and which reside, during a portion of the year at least, inside various bivalve shells, such as muscles, &c. The carapax of the females is suborbicular, very thin and soft whilst that of the males is firmer and nearly globular, and rather pointed in front; the legs are of moderate length, and the claws of the ordinary form; the tail of the female is very ample, and covers the whole of the underside of the body. The ancients believed that the Pea-crab lived upon the best terms with the inhabitant of the shell in which it was found; and that they not only warned them of danger, but went abroad to cater for them. The type is the *Cancer Pisum*, Lin., and Leach has investigated the species in his Malacostraca Podopthalma Britannica; [but this author has given the males and young as distinct species. See further J. V. Thompson's Memoir on this genus in the Entomol. Mag., vol. iii.]

The section consists of several other well-marked genera, such as *Grapsus*, Lamarck, *Plagusia*, Latr., &c.

The fourth section, ORBICULATA, have the carapax either somewhat globular, or rhomboidal, or ovoid, and always very solid; the ocular peduncles are always short, or but slightly elongated; the claws of unequal size, according to the sexes, those of the males being the largest; the tail never consists of seven entire segments; the oral cavity is gradually narrowed towards its superior extremity; and the third joint of the outer foot-jaws is always in the form of a long triangle; the posterior legs resemble the preceding, and none of them are very long.

Corystes, Latr., has the carapax of an ovoid-oblong form, with the lateral antennæ [nearly as long as the body]

and ciliated. The tail is composed of seven segments, but three of them are confluent in the males. The type is *Cancer personatus*, Herbst., found upon the coast of England. [This genus is of very difficult location, and has little real relation with *Leucosia*: it is more nearly allied to some of the arcuated species.]

Leucosia, Fab., has the carapax of variable form, but generally globular or ovoid, and as hard as stone; the lateral antennæ and eyes are very small; the tail, large and suborbicular in the females, is generally composed of four or five, but never of seven segments. Dr. Leach cut up this genus into many others. A very few species belonging to his genus *Ebalia* are found on the English coast. The majority of the family inhabit tropical seas.

The fifth section, TRIGONA, is of very great extent, and consists of species having the carapax generally irregular or subovoid, and narrowed in front into a kind of beak; ordinarily very rough and uneven, with the eyes lateral. The epistoma, or space between the antennæ and oral cavity, is always nearly square, and as long as broad. The claws, at least of the males, are always large and long. The following legs are very long in the majority, and occasionally the posterior pair have a form different from the preceding. The apparent number of joints in the tail varies, being seven in both sexes of the majority of species; but in others, at least in the males, it is less. Many of these crabs are commonly called sea spiders. Although the number of species of this section are very numerous, only two had been discovered in a fossil state; one of which, *Maia Squinado*, exists at the present time in the same localities.

Latreille divides this section into sub-sections, from the number of joints in the tail, and the form of the joints of the foot-jaws. Amongst those with the tail, either in both sexes, or in the females, composed of seven segments, *Parthenope*, Fabr., is distinguished by the immense size of the claws, and the smallness of the other legs; the fingers are suddenly bent downwards, the ocular peduncles very short, and the carapax exceedingly rough. A species found on the coasts of England and France (*Cancer asper*, Pennant) forms the genus *Eurynome*, Leach: the tail is seven-jointed. The other species of *Parthenope* are found in the Indian ocean.

Maia, Leach, has the fingers not deflexed; the anterior pair of legs scarcely thicker than the others, which are moderately long; the carapax has two frontal spines, and its back and sides are also armed with many tubercles and spines. The typical species, *Cancer Squinado*, Herbst., is very common on the coasts of France and the Mediterranean. It is one of the largest of our crabs, and was known to the ancient Greeks under the name of *Maia*, being sometimes figured on their medals. [By the fishermen it is called the Thorn-back, or King Crab.] Another common British species is the *Cancer araneus*, Lin., belonging to Leach's genus *Hyas*, having the carapax elongate, subtriangular, subtubercled, with the lateral margins dilated into a lanceolate projection, external antennæ with the first joint dilated.

Amongst the species, which have not more than six abdominal segments, and the legs generally long and filiform, and the third joint of the outer foot-jaw narrower than in the preceding subsection, *Hymenosoma*, Leach, has the carapax triangular or orbicular, depressed [and soft], and the basal joint of the lateral antennæ does not reach beyond the ocular peduncles. The species are small, and found in the Indian and Australian seas. The British genera, *Inachus* and *Achæus*, have the carapax subconvex and triangular, and their abdomen six-jointed. Their four pair of posterior legs are very long, especially the pair succeeding the claws. In the latter respect the British genus *Stenorhynchus*, Latr. (*Macropodia*, Leach), closely resembles them, having also the tail six-jointed in both sexes, and the front of the carapax notched. The type is the very common *Cancer Phalangium*, Pennant. The genus *Pactolus*, Leach, characterized by having the four hind-legs furnished with a didactyle claw [has been found by M. Milne Edwards to have been constructed upon a fictitious specimen in the British Museum].

Fig. 3.—Stenorynchus Phalangium.

Lithodes, Latr., is at once distinguished by having the hind pair of legs so small as to appear almost abortive. The type is a large crab of rare occurrence in British seas, named *Cancer Maia*, Linn. The tail is membranous; the outer foot-jaws are elongated and apart; the carapax is triangular, very spinous, and terminated in a toothed spine. [This is a very anomalous genus, whose relations are difficult to decide.]

[Professor Bell and De Haan have described many new and curious genera belonging to the section *Trigona*: the former, in the second volume of the Transactions of the Zoological Society; and the latter, in his work upon the Crustacea of Japan.]

The sixth section, CRYPTOPODA, is composed of a few species remarkable for having the legs, except the anterior pair, concealed, when folded up, beneath the dilated lateral margin of the carapax, which is nearly either semicircular or triangular; the upper edge of the claws is compressed, and formed like a cock's comb. The species are exotic, and compose the two genera *Calappa*, Fabr., and *Æthra*, Leach. In the shape of their claws they resemble some of the *Arcuata* and *Pinnipedes*, such as *Hepatus*, *Mursia*, &c.; so that this section should be placed higher in the series. The same may also be said with respect to the species of the following section, some of which approach the *Arcuata*, and others the *Orbiculata* and *Trigona*.

The seventh and last section, the NOTOPODA, *is formed of Crabs having the four or two posterior* legs inserted above the plane of the others, and seeming to be dorsal, and directed upwards. In those where they are not terminated by a sharp hook, the animal generally uses them to retain in its hold various marine productions, such as the valves of shells, sea-weeds, &c., with which it covers itself. The tail has seven joints in both sexes; the majority have the abdomen bent beneath the breast, and the legs terminated by a short hook, and unfitted for swimming.

Homola, Leach, have the carapax nearly square; the antennæ long; the ocular peduncles long; the claws of the males larger than the females, and the posterior pair of legs directed upwards. The outer foot-jaws are long and exposed [as in the *Macrura*]. The type, *H. spinifrons*, Leach, is a native of the Mediterranean, and is the *Hippocarcinus* of Aldrovandus.

Dorippe, Fab., has the four hind-legs elevated, as has also *Dromia*, Fab.

Dynomene, Latr., has the carapax of the ordinary form, and the two hind legs alone elevated.

Ranina, Lam., is a singular genus, differing from all other *Brachyura* in having the abdomen extended, [but not furnished at the end with an apparatus for swimming]; and from the other *Notopoda*, in having the six intermediate legs dilated and natatorial. The carapax is of a reversed triangular form, the front much toothed. The species are exotic.

[The *Brachyurous Crustacea*, here given as a single genus, *Cancer*, have, from the great number of species of which they consist, their large size, and facility of preservation, owing to their solid envelopes, attracted the attention of many recent authors. The Malacostraca Podopthalma Britannica, of Leach; the Histoire Naturelle des Crustacés, by Milne Edwards; the Fauna Japonica, of De Haan; the Memoirs of Professor Bell, published in the Transactions of the Zoological Society, and by Mr. MacLeay, in Dr. Smith's Illustrations of Southern Africa; together with Polydore Roux's elegant work upon the Crustacea of the Mediterranean, must be consulted by those who would desire to become acquainted with the singular forms and multitudinous genera established in this tribe of animals.]

THE SECOND FAMILY OF DECAPODA,—

DECAPODA MACRURA (*Exochnata*, Fabricius),—

Is distinguished by having, at the extremity of the tail, on each side, appendages*, ordinarily forming a swimmeret or instrument for swimming, the tail itself being at least as long as the body, extended, exposed, and bent under only towards the posterior extremity. Its under-side generally presents, in both sexes, five pairs of false feet, each terminating in two plates or filaments. The tail is always composed of seven segments. The branchiæ are formed of vesicular, bearded and villose pyramids, arranged, in many, either in two rows or in separate bundles. The antennæ are generally long and exserted; the ocular peduncles are mostly short. The external foot-jaws are generally narrow, long, and palpiform, and do not entirely hide the other [internal] parts of the mouth. The carapax is narrow and more elongate than in the Brachyura, and ordinarily terminated in front in a point. MM. Audouin and Milne Edwards (to whom we must refer for particulars) have noticed that in the lobster (*Astacus marinus*, Fab.), in addition to the two large lateral venous canals, there exists a third, lodged in the sternal cavity, in which respect the venous systems of the Macrura and Stomapoda agree. The Macrura never [or but in a very few instances] quit the water, and with a very few exceptions they are all marine.

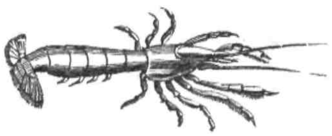

Fig. 4.—*Gebia stellata*, Leach.

Adopting the plan of Delper and Gronovius, the Macrura may be considered as forming but a single genus†, Astacus, which may be thus divided :—

* These appendages are composed of three pieces, namely, a base, (or support to the two others), articulating with the penultimate segment; the terminal segment generally forming with them a fan-like swimmeret; but in the terminal species the appendages are replaced by filaments. The sub-abdominal false legs are formed on the same model, and vary in number, there being only three or four small pairs in the Anomala, and wanting in the males (except the anterior pair). In the Hermit Crabs they seem to exist only on one side. But in the subsequent subgenera they are constantly larger, and there are five pairs, supporting the eggs and being useful in swimming. In the section Anomala, the peduncle of the intermediate antenna is proportionably longer, and the two or four posterior feet smaller, thus approaching the Brachyura.

† The sections which we have proposed ought rather to form so many genera, based upon those of Fabricius.

Tribe A [*Aschizopoda*, Westw.].—Those which, in the proportions, forms, and uses of the feet, the anterior, or at least the second, pair being cheliferous, and which carrying their eggs beneath their tails, approach the Brachyura, and which are ordinarily known under the names of Lobsters, Cray-fish, Prawns, and Shrimps. Divisible into four sections:—1. Anomala; 2. Locustæ; 3. Astacini; 4. Carides.

Tribe B [*Schizopoda*, Latr.].—Those which have the legs slender and filamentous, accompanied by an external articulated branch as long as the limbs, which thus appear doubled in number; fitted for swimming, and not cheliferous, the eggs being carried beneath them, and not under the tail. [Opossum Shrimps.]*

The first section [of the tribe *Aschizopoda*], or the ANOMALA.—The two or four hind legs are always much smaller than the preceding. The under side of the tail never presents more than four pairs of appendages, or false legs.† The lateral swimming-pieces at the extremity of the tail, or the parts which represent them, are thrown back at its sides, so as not to form with the terminal segment a fan-like swimmeret. The ocular peduncles are generally longer than those of the Macroura of the following sections. [Two subsections, Hippides and Paguriens.]

The subsection HIPPIDES (Latr.) has all the upper teguments of the body solid. The two fore-legs either terminate in a monodactyle or fingerless hand, like a plate, or they terminate in a point. The six or four following legs terminate in a swimming-plate. The two terminal legs are filiform, folded back, and situated at the lower base of the tail, which is suddenly narrowed after the first segment, which is short and broad, and of which the last is in the form of a long triangle. The lateral appendages of the penultimate segment are in the form of bent swimming-plates. The sub-abdominal appendages are four pairs, and formed of a very slender filiform stem. The antennæ are very pilose and ciliated, the lateral at first approaching the intermediate, and then being bent outwards.

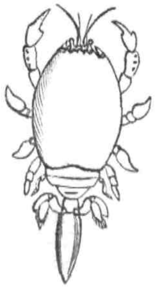
Fig. 5.—Remipes testudinarius.

Albunea, Fabr., comprises a single species from the Indian Seas (*Cancer Symnista*, Linn.) [a singularly formed animal], with long, setaceous, intermediate antennæ; the carapax flat, nearly square, rounded at the posterior angles; a pair of very compressed, triangular, monodactyle fore-legs,—the three following pairs terminated by a flat, sickle-shaped joint.

Hippa, Fabr., *Emerita*, Gronovius, has the antennæ short, the intermediate with two filaments longer than the external; the two fore-legs terminated by a very compressed claw, without fingers; the carapax ovoid. Type, *Cancer Emeritus*, Linn. Indian Seas.

Remipes, Latr., differs from the last in the four antennæ being very short, and nearly of equal length; the ocular peduncles very short, and in some other particulars. Type, *R. testudinarius*, Latr. From the seas of New Holland.

The subsection PAGURIENS has the teguments but slightly crustaceous; and the tail is generally soft, bag-like, and bent. The two fore-legs terminate in a didactyle claw; the four following terminate in a point; and the four posterior much shorter, in a small didactyle claw. The first joint of the peduncle of the lateral antennæ presents an appendage ending in a point, or in form of a spine. These Crustacea (which the Greeks named Carcinion, and the Romans Cancelli) live, for the most part, in empty univalve shells. The tail, except in *Birgus*, only presents (and that in the female alone) three false legs placed on one of the sides, each divided into two filiform villose branches. The three terminal segments are suddenly narrowed.

Birgus, Leach, has the tail solid, suborbicular, with two rows of plate-like appendages on the under side. The fourth pair of legs is but little smaller than the preceding; the two posterior pair are [very small, and] hidden in a groove in the extremity of the carapax. The carapax is in the shape of a reversed heart, being pointed in front.

On account of their large size, the solid consistence of their teguments, and the form of the tail, these Crabs are not able to lodge in shells, but must retire to crevices in the rocks, or hide themselves in burrows in the earth.

* [It is here proper to observe, that in the recent arrangements of Milne Edwards and M'Leay, the seventh and last section, Notopoda, of Latreille's arrangement of the Brachyura, and his first section of the Macroura, Anomala, constitute one of the three primary divisions of the Decapoda, forming, as may be readily perceived, the passage between the Brachyura and the Macroura; and, as constantly occurs where nature passes from one type of form to another, we find amongst these animals some of the most striking anomalies which occur in the class—hence the name Anomoura, or anomalous-tailed Crabs—which are divided by M. Edwards into two primary sections or families:—1. The Apterura, or those destitute of a terminal swimmeret, including the Dromiens, Homoliens, Raniniens, and Pactoliens; and, 2. The Pterygura, or those which have a pair of moveable appendages at the extremity of the tail, including the Porcellaniens, Hippiens, and Paguriens. Thus it will appear that the former section is more analogous to the Brachyura, and the latter to the Macroura.]

† With the exception of the anterior pair, these appendages are either rudimental or obsolete in the males,—a peculiarity which occurs also in the Galathææ, Scyllari, and Palinuri. We may also observe, that in these three genera, the swimmerets at the extremity of the body are more slender, or nearly membranous, at the posterior margin. In this section, as in Galathæa, the portion of the thorax which supports the hind pair of legs forms a sort of peduncle, whence this pair of legs appears to be attached to the tail.

The best known species (*Cancer latro*, Linn.) inhabits the Isle of France; and, according to a native tradition, it feeds upon the fruit of the cocoa-nut, making its excursions during the night. [It is of large size, and is called the Purse Crab. Mr. Cuming found it in abundance in Lord Hood's Island in the Pacific, living at the roots of trees. Messrs. Quoy and Gaimard fed this species for many months on cocoa-nuts; and Mr. Cuming discovered that it climbs the *Platanus odoratissima*, to feed upon the small nuts of that tree.]

In the Hermit Crabs (*Pagurus*, Fabr.), the four hind-legs are much smaller than the preceding, with the claws covered with small tubercles. The tail is soft, long, cylindrical, narrowed at the tip, and only furnished with one row of filiform, oviferous appendages. The thorax is ovoid or oblong.

With the exception of some superficially-known species which live in sponges, serpulæ, alcyons, &c., all the others live in univalve shells, of which they close the mouth with their fore-legs and one of their claws, which is larger than the others. It is stated that the females deposit their eggs two or three times in a year.

[The manœuvres of the native species, when they have outgrown their habitations, are quite ludicrous. Crawling slowly along the line of empty shells, &c., left by the last wave, and unwilling to part with their now incommodious domicile until another is obtained, they carefully examine, one by one, the shells which lie in their way, slipping their tails out of the old house into the new one, and again betaking themselves to the old one, if this should not suit. In this manner they proceed until they have found a habitation to their liking. They feed upon dead fish, and all kinds of garbage thrown on the shore; and, when alarmed, they draw themselves closely into the shell, closing the aperture so firmly, by placing their claws over the entrance, that it is next to impossible to extract them without breaking the shell to pieces.]

Some species, forming the subgenus *Cœnobita*, Latr., are distinguished by the antennæ stretched forward, the intermediate pair being nearly as long as the lateral ones; the thorax ovoid, conical, narrow, elongated, and very much compressed at the sides. These lodge in land-shells on the rocks of the coasts, rolling down, with their houses, in moments of danger. The other species, forming the most numerous subgenus, *Pagurus*, have the intermediate antennæ short and bent, with two short filaments. The front division of the thorax is square, or reversed triangular.

Cancer Bernhardus, Linn. (*Pagurus streblonyx*, Leach), is very common on the coasts throughout Europe. It is of a moderate size. Its two fore-legs are armed with points, with the claws nearly heart-shaped, that on the right-hand side being the largest. *Pag. Faujasii*, Desmarest, a fossil species, approaches it very closely.

Another species from the Mediterranean differs from the rest in many characters, and forms the subgenus *Prophylax*, Latr. The tail is coriaceous, linear, and only curved at the tip; and it has two rows of subabdominal appendages. Probably the species which live in serpulæ, alcyons, &c., such as *Pagurus tubularis*, Fabr., belong to this subgenus.*

In all the subsequent Macroura, the two posterior legs alone are smaller than the preceding. The subabdominal appendages are generally five pairs. The teguments are crustaceous. The lateral appendages of the penultimate segments form a fan-like swimmeret in conjunction with the terminal one.

The two following sections have a character in common, which separates them from the fourth, or that of the Carides. The antennæ are inserted [in a line] at the same height, the peduncle of the lateral pair being never entirely covered by the scale when present. Often there are only four pairs of the false subabdominal feet. The intermediate antennæ are never terminated by two threads: they are ordinarily shorter, or scarcely as long as their peduncle. The external plate of the swimmeret is never transversely divided by a suture.

The second section, LOCUSTÆ (so named from the Latin name Locusta, given to the most remarkable species of this section by the Romans), have only four pairs of false legs. The extremity of the swimmeret at the end of the tail is always nearly membranous, or less solid than the rest. The peduncle of the intermediate antennæ is always longer than the two terminal filaments, and more or less elbowed. The lateral pair have no basal scale, and sometimes they are even widened to a short but greatly-dilated plate: sometimes they are very large, long, and much spined. The legs are all nearly alike, and terminate in a point,—the anterior pair being but slightly larger than the following; their penultimate joint, as well as that of the two posterior, is at most unidentate, but not so much so as to form a perfectly didactyle hand. The carapax has no frontal elongation, like a pointed beak or lance.

Scyllarus, Fabr., exhibits, in its lateral antennæ, a perfectly isolated character, the terminal filament being obsolete, and the basal joints greatly dilated transversely, forming a broad, flat, horizontal, and more or less toothed crest. The outer branch of the subabdominal appendages is terminated by a leaflet, but the inner one, in some males only, appears in the form of a tooth. Leach separated them into the genera *Scyllarus*, *Thenus*, and *Ibacus*, founded upon the proportions and forms of the thorax, the position of the eyes, and other parts. They form burrows in argillaceous ground near the shores, in which they reside. Type, *Scyllarus arctus*, Linn. *Scyllarus æquinoxialis*, Fabr., is another species, the flesh of which is greatly esteemed [in the Mediterranean].

Palinurus, Fabr., have the lateral antennæ large, setaceous, and set with sharp points. These Crustacea, called by the Greeks Carabos, and by the Romans Locusta, are amongst the largest animals of the class. The [common]

* [M. Milne Edwards has published a valuable monograph upon the Paguridæ in vol. vi. of the new series of the *Annales des Sciences Naturelles*, which has been abstracted in vol. ii. of his *Hist. Nat. des Crustacés*.]

species of our climate [known in the fish-shops under the name of the Spiny Lobster] is found during the winter in deep water, approaching the coast only at the return of the spring. It prefers rocky situations. It then lays its eggs, which are extremely numerous, minute, and bright red. According to Risso, they again breed in August. The different species are found in the seas of temperate and intertropical zones. The carapax is rough, and strongly armed with sharp points or teeth, especially in front. Their colours are varied with red, green, and yellow. The tail is often banded, or marked with eyes. The flesh, especially of the females before and during the breeding season, is greatly esteemed.

The common English typical species, *Palinurus quadricornis*, Fabr. (*Astacus elephas*, Leach), is of a large size; and, when loaded with eggs, weighs twelve or fourteen pounds. It is found upon the French coasts as well as our own. It is very abundant on the shores of the Mediterranean, and has also been found in the fossil state in Italy.

The third section, ASTACINI (Latr.), is distinguished from the preceding in the form of the two fore-legs, and often also in that of the two following pairs, which terminate in claws with two fingers. In some, the two or four hind-legs are much smaller than the preceding, in which respect they approach the Anomala; but the fan-like swimmeret at the extremity of the tail, and other characters, remove them from that section. The thorax is narrowed in front, which is produced into a beak or pointed muzzle.

The first subsection, GALATHADEÆ, have, as well as the preceding Macroura, four pairs of false legs. The intermediate antennæ are elbowed with two filaments, which are clearly shorter than their peduncle; and that of the lateral antennæ is never furnished with a scaly plate. The two fore-legs are alone terminated by a didactyle claw, which is often very broad and flattened. The terminal segment of the tail is bilobed, at least in the majority.

Those species which have the two hind legs much more slender than the preceding, filiform, folded, and useless in crawling, are the two following genera. *Galathea*, Fabr., having the tail extended, the thorax nearly ovoid or oblong, the intermediate antennæ exposed, and the claws long. The upper surface of the body is generally transversely wrinkled, spinose, and ciliated.

Cancer strigosus, Linn., and *C. rugosus*, Pennant, are two common species on our English coasts. *G. gregaria*, Fabr. (forming Leach's genus *Grimotea*), is of a red colour; and was discovered by Sir Joseph Banks in his voyage round the world, abounding in some parts of the ocean in such vast quantities that the surface of the water appeared as if saturated with blood. [Gray, in his *Zoological Miscellany*, and M. Edwards, have described many species of this genus.]

Porcellana, Fabr., forms, amongst the Macroura, a remarkable exception in respect to the structure of the tail, which is bent under the body, as in the Brachyura. It differs from *Galathea* in its broader outline, the carapax being often suborbicular, or square. The claws are triangular, the basal joints of the outer foot-jaws are dilated, and the body is very flat. They are of small size, slow in their movements, and are distributed in all the seas, hiding themselves beneath stones on the shore. Some species have the claws very large, villose, and very much ciliated: amongst which is the common English species *Cancer platycheles*, Pennant, of which the outside of the claws is alone hairy, and the thorax naked and rounded. Others have the claws naked, including *Cancer hexapus*, Linn.

Monolepis, Say, seems to be intermediate between *Porcellana* and *Megalopus*, Leach; (*Macropa*, Latr.) The latter differs from the preceding in having the hind pair of legs similar in form and function to the preceding pairs; the body much more thick and raised; the eyes large; the lateral plates of the anal swimmeret composed of a single piece; and the abdomen extended, narrow, and merely curved beneath at its extremity. Four species are known: three found in the European seas, and the other in the Indian Ocean. [Dr. J. V. Thompson, in his Memoir published in the *Philosophical Transactions*, has expressed his opinion that these animals are the young of a Brachyurous Crab. The abdomen is, however, furnished beneath with a double pair of false legs, as in the Macroura; and the tail is terminated by a swimmeret. The branchiæ are arranged, however, as in the Brachyura. M. Edwards considers them as the young of some of the Anomoura.]

The second subsection (ASTACINI proper) comprises those species which have four pairs of false [sub-abdominal] feet; the intermediate antennæ straight, or nearly so, porrected, and terminated by two filaments as long as or longer than the peduncle, and which (except in *Gebia*) have the four or six fore-legs terminated by a didactyle hand. The tail is always extended. The two hind-legs never much slenderer than the preceding, nor bent backwards. The peduncle of the lateral antennæ is often provided with a scale. Some species, as in some of the following sections, live in fresh water.

Amongst those which have not more than the four fore-legs terminated by two fingers, the lateral antennæ not furnished with a scale at the base, the outer piece of the lateral plate of the swimmeret without any transverse suture, and which are marine, hiding themselves in burrows which they form in the sand, are the genera *Gebia*, Leach [comprising a small British species], and *Thalassina*, Latr. [a singular genus from the East Indies]; and in both of which the immoveable finger of the claws is very short, whilst it is as long as the moveable finger in the genera *Callianassa*, Leach, in which the fore-claws are very unequal both in their size and form (including a single species, *C. subterranea*, Leach, found on the English and French coasts); and *Axius*, Leach, in which the

claws are nearly equal, consisting also of a single species (*Axius stirhynchus*, Leach) found upon the coasts of England and France.

Amongst those species which have the six fore-legs forming as many didactyle claws—(a character which removes them from all the preceding Decapods, and in which they are related to the species at the head of the following section—from which, however, they differ in the fore-claws being by far the largest, the peduncle of the lateral antennæ furnished with a scale or spines, the outer plate of the swimmeret at the extremity of the tail appearing in all the recent species, as though it is divided into two parts by a transverse suture,)—are the following genera.

Eryon, Desm., comprises a single singular fossil species found in the calcareous stone used for lithography at Pappenheim and Aichtedt, in Anspach. The carapax is [very broad], and with very deep lateral incisions. The plates of the swimmeret are pointed at the tip.

The genus *Astacus*, Gronovius, Fabr., have the lateral plates of the swimmeret broad and rounded at the extremity; the two exterior ones with a transverse suture. The two filaments of the intermediate antennæ are longer than their peduncles, with the sides of the carapax entire.

In the marine species of this genus, the middle plate of the tail does not exhibit a transverse suture. Of some of these, Leach has formed his genus *Nephrops*, characterized by the large scale of the lateral antennæ, and the long prismatic claws of the fore-legs. Type, *Cancer norvegicus*, Linn., a species found on our coast. The others having the lateral antennæ only furnished with two short teeth or spines, and the fore-claws large and oval, form the restricted genus *Astacus*, Leach, the type of which is the common Lobster (*Cancer gammarus*, Linn.; *Astacus marinus*, Fabr.), of which the rostrum in front of the carapax is armed with three teeth on each side, and a double tooth at the base; and the claws are very large, and unequal in size. The flesh is highly relished. It is found in the European Ocean, the Mediterranean, and on the coasts of North America. The internal structure has been studied with great diligence by MM. V. Audouin and M. Edwards.

In the fresh-water species of this genus, the terminal segment of the tail, forming the middle plate of the swimmeret, is transversely divided by a suture*; and the claws are rough, and finely toothed on the inside of the fingers. The rostrum has a tooth on each side, and two at the base. It is ordinarily of a greenish-brown colour, [but, like the lobster, changes to bright red by boiling]. From its common occurrence it has been greatly studied, not only as regards its anatomy, but also its habits, and the peculiar power it possesses of renewing its antennæ and legs when thrown off or mutilated. The stomach contains, at the time of moulting, two stony secretions, formerly used in medicine as absorbents, but which are now replaced by carbonate of magnesia. It hides itself under stones and in burrows [in the banks of rivulets and streams], whence it only comes forth in order to search for its food, which consists of small mollusca, small fishes, and the larvæ of aquatic insects. It also feeds upon decaying flesh, and the carcases of animals floating in the water; and which is also used as a bait, being placed in the middle of a bundle of faggots, or in a net. Its moulting takes place at the end of the spring. Two months after coupling, the female lays her eggs, which are at first collected in a mass, and attached, by means of a viscid liquor, to the subabdominal false legs. They are of a bright red colour, and increase in size before they are hatched. The Crayfish are at their birth very soft, and completely resemble their parent. They take refuge beneath her tail, where they remain several days until the different parts of their bodies have acquired a sufficient strength. They live to the age of twenty years, increasing in size in proportion to their age. Those are preferred which are found in running water. A singular Annelidous parasite (*Branchiobdella*, Odier, in *Mem. Soc. d'Hist. Nat.*, Paris, p. 69), first observed by Rosel, infests the branchiæ of the Crayfish.

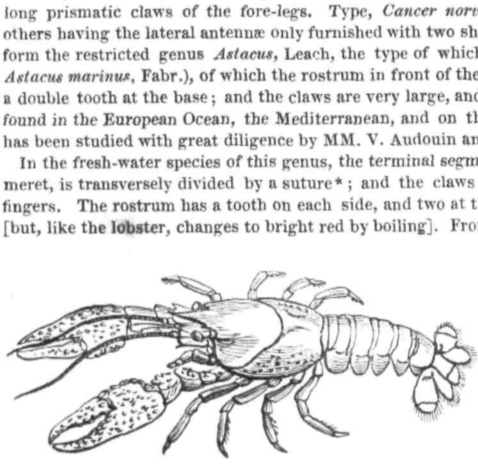

Fig. 6.—The Crayfish.

Another species inhabits the fresh water of North America; and a third, according to Le Conte, does much injury to the rice plantations of the same country.†

The fourth section, CARIDES (Latr.), have the intermediate antennæ inserted higher than the lateral, and the peduncle of the latter is covered by a large scale. The body is arched, as though hunch-backed, and of a more slender consistence than in the preceding Crustacea. The front of the carapax

* [Milne Edwards, from having adopted an evidently improper mode of nomenclature, has taken away from the two best known Decapod Crustacea, the old generic names which they are clearly entitled to retain. Thus he calls the common Crab, which is the true type of the genus Cancer, *Platycarcinus*; against which impropriety Mr. Bell has well remarked, that by any other term than Cancer to this genus, we are obliged to restrict the word Cancer to a small and comparatively unimportant group, not a single species of which was probably distinctly known to any naturalist of early times. In like manner, he has taken away the name Astacus from the Lobster, and given it to the Crayfish, and proposed the new name Homarus for the former: thus doing injustice to Dr. Leach, who, in the manuscripts quoted in the *Entomologist's Compendium* (with which Milne Edwards is evidently unacquainted), had called the Lobster *Astacus gammarus*, and the Crayfish *Potamobius fluviatilis*. It is proper, however, to observe, that the latter had been named *Cancer astacus* by Linnæus.]

† [The developement of the embryo Crayfish, in the egg, has been investigated by Dr. Rathke, in a most elaborate and satisfactory manner, in his *Untersuchungen uber die Bildung und Entwickelung der Flusskrebsen*, fol. Leipz. 1829. Some idea of the extent of the researches of this author upon the subject may be entertained from the fact that five large folio plates are completely filled with details of the structure, internal and external, of the ova, in various states of developement, and of the newly-hatched animal, from whence it is impossible to arrive at any other conclusion than that the Crayfish does not undergo any change of form which can in the least degree merit the name of metamorphosis. A full abstract of this valuable memoir is inserted in No. 18 of the *Zoological Journal*, and in the *Annales des Sciences Naturelles* for August, 1831.]

is always prolonged into a point, often forming a sharp-pointed plate, very much compressed, and toothed on both edges. The antennæ are always advanced; the lateral ones generally very long, and in the form of a very slender thread: the intermediate antennæ, in the majority, are terminated by three filaments. The eyes closely approach each other. The outer foot-jaws, longer than ordinary, resemble palpi or antennæ. One of the two fore pair of legs is often folded back, or doubled. The segments of the tail are dilated laterally. The outer plate of the terminal swimmeret is always divided in two by a suture, as in the terminal species of the preceding section. The middle piece, or the seventh and last segment of the tail, is long, narrowed towards the tip, and is armed above with rows of small spines. The false legs, of which there are five pairs, are long and foliaceous. These Crustacea are much eaten in different parts of the world, and some species are salted for keeping.*

Those which have the three anterior pairs of legs didactyle, the length gradually increasing, so that the third pair is the largest, compose the genera *Penæus*, Fabr., (having no annular divisions in the joints of the legs, and composed of numerous species, one of which, the Caramote (*P. sulcatus*, Oliv.), is very common in the Mediterranean, and is a great object of commerce, being salted for exportation to the Levant, and of which the English species (*P. trisulcatus*, Leach) is considered by Latreille to be a local variety),—and *Stenopus*, Fabr., having the two penultimate joints of the four posterior legs with annular divisions.

The remaining species have not more than the two anterior pairs of legs didactyle, and the intermediate antennæ terminated by three filaments.

Atya, Leach, formed of a single North American species, *A. scabra*, is anomalous in the form of its four claws, which are small, and split to the base with long terminal pencils of hair, the preceding joint being crescent-shaped.

The others have the claws of the ordinary didactyle form. These, with the exception of the terminal genus, have the legs more or less robust, but not filiform, without any appendage at the base. The body is neither very soft, nor very much elongated.

Crangon, Fabr., has the fixed finger or index of the two anterior and largest claws reduced to a small tooth, the moveable finger being hook-shaped. The superior or intermediate antennæ have only two terminal filaments; the second legs are folded, and more or less distinctly didactyle at the tips; none of the joints are annulated; the rostrum is very short. *Crangon vulgaris*, Fabr., the Common Shrimp, is the type of this genus. It does not exceed two inches in length, and is of a pale glaucous green colour, dotted with grey. It is caught throughout the year with the assistance of circular nets. Its flesh is delicate.

Pontophilus, Leach (*Egeon*, Risso), does not generically differ from *Crangon*.

Processa, Leach (*Nika*, Risso), has one of the fore-legs terminated in a point, and the other didactyle. The second pair of legs are of unequal length, one being very long, with the two joints preceding the claw annulated. *N. edulis*, Risso, found at the mouth of the Rhone.

Hymenocera, Latr., differs in the proportions and form of the legs.

To these succeed a number of genera in which the legs and claws do not present any anomalous structure, and in which the superior or intermediate antennæ have only two terminal filaments, including the genus *Hippolyte*, Leach, comprising several British species of shrimps, and in which the four fore-legs are terminated by a didactyle claw, the second pair being longer than the first; and *Pandalus*, Leach, comprising another British species (*P. annulicornis*, Leach), in which the fore-legs are [very small and] simple, or scarcely bifid; the two following long, of unequal length, with the two joints preceding the claw annulated.

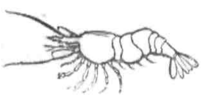
Fig. 7.—Hippolyte varians.

The Prawn is the type of the genus *Palæmon*, which differs from the last group of genera in having the upper antennæ terminated by three filaments. It has the two anterior pairs of legs didactyle, the smaller pair being folded; and the carpus is not articulated. The rostrum is very long [and spined]. Some of the exotic species acquire a very large size, with the second pair of legs very long. The flesh of the common species is more esteemed than that of the Shrimp. According to M. de Brebisson (*Cat. Méth. Crust. Depart. du Calvados*), they are caught in the same manner as Shrimps, but only in summer. They swim well, especially when alarmed, and in different directions. They frequent the coast. The lithographic stone of Pappenheim and Sohlnofen often contains the remains of a fossil species, which Desmarest names *Palæmon spinipes*. Another fossil species, but of a much larger size, has been found in England. The species ordinarily sold in the fish-shops is the *Palæmon serratus*. It is generally three or four inches long, and of a pale red colour, which is brightest in the antennæ, and especially in the swimmeret of the tail. Its frontal spine extends beyond the peduncle of the middle antennæ: it is curved upwards at the tip, with seven or eight spines above, and five beneath. One of the sides of the body is often distended, which is caused by a parasite of the genus *Bopyrus* beneath the carapax, affixed to the branchiæ. *Palæmon squilla*, Linn., is another but smaller

* [The gradual developement of several species of Carides (Palæmonidæ) has been recently described by Dr. J. V. Thompson in Jameson's *Edinb. Phil. Journ.*, Oct. 1836, and by Captain Ducane in the *Annals of Nat. Hist.*, Nov. 1838. On first bursting from the egg, the tail is terminated by a spatulated plate, destitute of lateral as well as subabdominal appendages; the rostrum is produced into a simple point; the lateral antennæ exhibit only the large scale; and only two of the legs are of the ordinary length, and these are bifid, as in the Schizopods; the other legs are very minute, and incurved. In the course of several moultings, the antennæ are lengthened; the rostrum and ridge of the carapax spined; the five pairs of legs extended to their full size, but still bifid; and the subabdominal appendages and the swimmerets gradually developed. These observations are asserted, by M'Leay and others, to afford a complete confirmation of the correctness of Thompson's assertions that Zoea is the larva of the common Crab, and that all the Crustacea undergo transformations,—these gentlemen overlooking the fact that Zoea is a Decapod animal, not furnished with bifid legs, but having the two pairs of outer foot jaws immensely developed, but of the ordinary Macrourous construction, as are the internal parts of its mouth.]

British species, having the frontal rostrum not extending beyond the peduncle of the superior antennæ, and nearly straight.

[Other genera have been proposed by Risso, Leach, P. Roux, and M. Edwards, founded upon variations in the form and proportions of the legs.]

Pasiphæa, Savigny, is a very interesting genus, allied to the preceding in the upper antennæ, terminated by two filaments; the four fore-legs terminated by a didactyle claw, but [differing from all the other Carides] in having the external base of the legs furnished with a thread-like appendage; the claw-legs are larger, nearly equal in size, very slender, and filiform; the body is very long, very compressed, and very soft. Type, *P. Sivado*, Risso. Found in the Mediterranean, especially in the Bay of Nice, where it is very abundant.*

The fifth and last section of the *Macroura*—that of the SCHIZOPODA—appears to unite them with the subsequent order. The legs are very slender, like flattened threads, and not furnished with claws, but having a longer or shorter lateral appendage arising on their outside near the base, and [the legs are] fitted only for swimming. The eggs are borne between them, and not under the tail. The ocular peduncles are very short. As in the majority of the Macroura, the front is prolonged into a kind of rostrum. The carapax is very slender. The tail terminated, as is customary, in a swimmeret. These Crustacea are minute and marine.

In some, the eyes are very apparent; the lateral antennæ furnished with a scale; the intermediate ones terminated by two filaments, and composed of many minute joints, as in the preceding.†

Mysis, Latr., has the antennæ and legs uncovered; the carapax long, nearly square, or cylindrical; the eyes close together; and the legs capillary, and formed of two thread-like filaments. Type, *M. Fabricii*, Leach; *Cancer scutatus*, O. Fabricius.

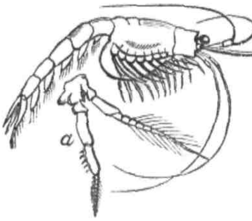

Fig. 8.—Mysis vulgaris, about twice the natural length.
a, one of the bifid legs.

[The species of Mysis are termed Opossum Shrimps, from their singular economy of carrying their eggs and young in a large pouch, with membranous envelopes, beneath the thorax and between the thoracic legs. Their structure has been fully investigated by Thompson in his *Zoological Researches*. In the *Encyclopédie Méthodique* are also some figures communicated by Dr. Leach to Latreille, and evidently intended for the *Malacostraca Britannica* of the former author, but which were never published by him.

Two other genera, nearly allied to *Mysis*, have been proposed by Thompson, founded upon oceanic species, namely:—

Cynthia, having branchiæ attached to the subabdominal fins; and *Noctiluca*, founded upon a luminous species, but not described with sufficient precision, and omitted by M. Edwards.

Thysanopoda (Edwards), in which there are also eight pairs of bifid natatory feet, but the branchiæ are in the form of many-branched, membranous appendages, at the base of the true legs.

The genera *Phasmatocarcinus*, Tilesius (in the *Neue Annalen Wetterausch Gesellschaft*, vol. i.), considered by Thompson and Edwards as undescribed, and named by the former *Lucifer* (*Leucifer*, Edwards), and that of *Podopsis* by Thompson, are amongst the most singular of known Crustacea, having a filiform body, with very large globular eyes placed at the extremity of very long and laterally extended foot-stalks; and the legs are exceedingly slender and short. According to Slabber, whose figure of one of the species has been overlooked by all Crustaceologists, there are eight pairs of legs of equal size.]

Cryptopus, Latr., has the carapax subovoid, swollen, bent under at the sides, enveloping the body, as well as the antennæ and legs, having only on the under side a longitudinal slit. The eyes are wide apart. The legs are like flattened threads, with a lateral appendage. Type, *C. Defrancii*, Latr. Mediterranean.

In others, the eyes are hidden. The intermediate antennæ conical, exarticulated, and very short. The lateral antennæ composed of a peduncle and a filament, without distinct articulations: their base is not protected by a porrected scale.

Mulcio, Latr., has the body very soft; thorax ovoid; legs like flattened threads, the majority with an ap-

* [Many additional genera have been added to the Carides by Polydore Roux in his *Mémoire sur la Classification des Crustacés de la Tribu des Salicoques*, Marseilles, 1831; and by Milne Edwards in the *Annales des Sciences Naturelles*, and *Hist. Nat. des Crustacés*. Of these it will be necessary only to notice those of *Sicyonia*, nearly allied to Penæus, but differing from it and all the other genera in having no appendages to the false subabdominal legs, and in the modifications of its respiratory apparatus, there being only eleven pairs of branchiæ instead of eighteen. *Sergestes* and *Acetes*—in which the posterior pair of true legs is almost rudimental, or entirely obsolete, the outer pair of foot jaws being immensely developed, so as to constitute an anterior pair of legs to supply their place. These genera are founded upon exotic species.]

[Here terminates, in the system of M. Edwards, the great order of Decapod Crustacea, which, in his *Hist. Nat. des Crustacés*, is succeeded by an appendix consisting of "Decapodes douteux," comprising the genera Zoea, Cerataspis, Mulcio, and Posydon. With respect to Zoea, I have clearly proved in my Memoir, published in the *Philosophical Transactions*, that it is a Decapod; and therefore the observations of Latreille, at the end of the Decapods, cannot be adopted.]

† [The Schizopoda having, since the publication of the second edition of this work, been well investigated by Edwards and Thompson, have been found to be more nearly allied to the order Stomapoda, although presenting so near a resemblance to the Carides. This innovation was adopted by Latreille himself in his *Cours d'Entomologie*, in which this author has proposed to give those Podopthalmous Crustacea which are destitute of thoracic internal branchiæ, but otherwise resembling the Carides, the sectional name of Caridioides, indicative of their analogy with the last-named group. The typical genus Mysis is especially interesting, on account of the complete transformation of all the three pairs of foot-jaws into legs, so that, together with the five pairs of true legs, there are eight pairs of locomotive organs; and as each of these is divided from the base by the addition of a lateral appendage, these animals may be said to have not fewer than thirty-two legs.]

pendage at the base, the fourth pair being the longest. I only know one species (*M. Lesueurii*), collected in the seas of North America. Olivier found, in the *Penna marina*, a crustaceous animal very similar at the first sight; but the specimens were so much injured that I was not able to study its characters.

The *Nebaliæ*, which I had at first placed in this section, not having any natatory appendages under the terminal segments of the body, and their legs being very similar to those of *Cyclops*, I have introduced, together with *Condylura*, at the head of the order Branchiopoda. *Nebalia*, in its exposed eyes, which appear to be pedunculated, and in some other characters, seems, in conjunction with *Zoea*, to unite the *Schizopoda* with the *Branchiopoda*.

THE SECOND ORDER OF CRUSTACEA,—

STOMAPODA (commonly called SEA-MANTES),—

Have the branchiæ naked, and adhering to the five pairs of appendages attached beneath the abdomen or tail, which this part of the body also presents to us in the Decapods, which appendages here, as in the majority of the Macroura, are used in swimming, or are fin-feet. The carapax is divided into two parts, of which the anterior bears the eyes and intermediate antennæ, or more properly composes the head without supporting the foot-jaws. The latter organs, as well as the four fore-legs, often closely approach the mouth in two lines, converging inferiorly: whence arises the name Stomapoda, given to this order.

The heart—to judge at least from the *Squillæ*, the most remarkable genus in the order, and the only one in which it has been studied—is elongated, and resembles a large vessel extending the whole length of the back, and terminating posteriorly near the anus, in a point. The teguments of the Stomapoda are slender; and, in some species, almost membranous and diaphanous. The carapax, or shell, is sometimes formed of two shields, of which the anterior represents the head, and the other the thorax, sometimes of a single piece, but free behind, leaving generally uncovered the thoracic segments, which bear the three hind pairs of legs, and having in front an articulation serving as a base for the eyes and intermediate antennæ: the latter organs are always terminated by two or three filaments. The eyes are always close together. The composition of the mouth is essentially the same as in the Decapods; but the palpi of the mandibles, instead of being adpressed to them, are always raised. The foot-jaws are not furnished with the whip-like appendage (*fouet*) which exists in the Decapods. They have the form of claw-legs, or small feet; and, in many at least (*Squilla*), the base externally exhibits, as well as that of the two fore-legs, properly so called, a vesicular body. The second pair of foot-jaws, in the same Stomapods, is much larger than the others, and even than the legs themselves: hence they have been generally considered legs, and the number of these organs has been stated to be fourteen.* The four anterior [true] legs have also the form of claw-feet; but are terminated, like the foot-jaws, by a hook which folds upon the inferior and anterior edge of the preceding joint. But in some others, such as the *Phyllosomæ*†, all these organs are filiform, and without any didactyle claw. Some of these, however, as well as the six hind-legs of the *Squillæ*, are furnished with a lateral appendage or branch. The seven terminal segments of the body—inclosing a considerable portion of the heart, and to which the respiratory organs are attached—cannot, moreover, in this respect, be considered analogous (*assimilés*) to that portion of the body which is called the tail in the Decapods, being an abdomen, properly so called. Its penultimate segment has, on each side, a swimmeret formed in the same manner as that of the tail of the Macroura, but often armed, as well as the terminal segment or intermediate piece, with spines or teeth.

All the Stomapoda are marine, preferring tropical climates, and not going beyond the tem-

* The second pair of true maxillæ of the *Squillæ* has not the same form as in the Decapods, being of an elongated, triangular form, divided into four joints by transverse lines. The mandibles are bifurcate, and very much notched.

† In all those which have the four anterior feet claw-like, the six posterior are formed for swimming.

perate zones. Although we have observed a very great number of individuals, we have never met with one carrying eggs. Their habits are entirely unknown. It is, however, beyond a doubt, that those species with powerful claws use them for the purpose of seizing their prey in the same manner as those Orthoptera which are named Mantes*; and it is on account of this conformity that these Stomapods have received the name of Sea-Mantes. They were named Crangones, or Crangines, by the Greeks.

According to M. Risso, they keep in deep water, in sandy and muddy bottoms, and couple in the spring; but other species, forming our second family, being less favoured in respect to their natatory appendages, and having the body very flat and extended in its surface, are ordinarily found on the surface of the ocean, where they move but slowly.

We divide the order Stomapoda into two families. In

THE FIRST FAMILY OF STOMAPODA,—

UNIPELTATA,—

The carapax forms only a single shield of a quadrilateral, elongated shape, generally widened and free behind, covering the head (with the exception of the eyes and antennæ, which are implanted upon common and frontal articulations), and at least the anterior segments of the thorax. Its anterior extremity terminates in a point, and is preceded by a small plate terminating in the same manner. All the foot-jaws (of which the second pair is very large), and the four anterior feet, are inserted close to the mouth in two lines converging inferiorly, in the form of claw-feet, with a single moveable and folded back finger. With the exception of the second pair of legs, all these organs are externally furnished at the base with a small pedunculated vescicle. The other feet, six in number, are linear, terminated by a brush, and merely natatorial: the third joint is furnished at the side and base with a slender appendage. The lateral antennæ have a scale at the base, and the intermediate are terminated by three filaments. The body is narrow and elongated. The ocular peduncles are always short. This family comprises the single genus

SQUILLA (Fabr.),—

which we divide as follows :—

In some species, the crustaceous shield [or carapax] is preceded by a small, more or less triangular, plate, situated above the articulation which bears the intermediate antennæ and the eyes. It does not cover the anterior portion of the thorax, and is not bent down at the sides. The joint which serves as a footstalk to the peduncle of the intermediate antennæ, as well as to the ocular peduncles and the exterior margins of the extremity of the abdomen, is exposed.

Squilla proper, Latr., has the entire inner edge of the penultimate joint of the two great claw-feet furnished with a narrow channel, denticulated on one side, and spined on the other; and the following joint is sickle-shaped, and often toothed. The type (*Cancer mantis*, Linn.) is about seven inches long. Its great claws have at the base three moveable spines; and the terminal joint has six long and very sharp spines, of which the terminal is the strongest. The segments of the body, except the last, have six longitudinal elevated lines, ordinarily terminating in an acute point. It is common in the Mediterranean.

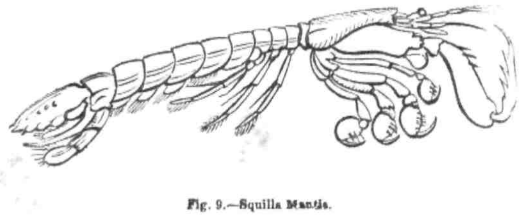

Fig. 9.—Squilla Mantis.

Gonodactylus, Latr., has the channel of the great claws unarmed with points; and the terminal joint is dilated into a knob at its base. The species are exotic. (*Squilla chiragra*, Fabr.; Desmarest, pl. 43.)

Coronis, Latr., has the body very narrow and depressed, with the terminal segment square and entire, without teeth or spines. The lateral appendage of the six hind-legs is pallet-shaped. [*C. scolopendra*, Latr., regarded by him as synonymous with *Squilla Eusebia* of Risso; but the figure given by this author in his *Hist. Nat. Europ. Merid.*, tom. v. pl. 4, has the terminal segment deeply toothed.]

In the other species of this family, the carapax is slender, nearly membranous, diaphanous, entirely covering the thorax, bent down at the sides, prolonged in front into an acute spine, and advanced over the stem of the intermediate antennæ, and the eyes. This stem is capable of being bent downwards, and inclosed in the shield formed by the curve of the carapax. The posterior swimmerets are hidden beneath the terminal segment.

* Some other analogous Orthoptera (such as the genus *Phyllium*) resemble leaves. The Phyllosomæ, Crustacea of the same order, exhibit to us the same analogy.

These minute and delicate Crustacea are peculiar to the Atlantic Ocean and the Indian Seas. The fingers of the large claw-legs are not toothed. The second joint of the ocular peduncles is much larger than the basal joint, and in the form of a reversed cone. The eyes themselves are large, and nearly globular. The appendages of the swimming or fin-feet resemble those of the *Squillæ*.

Erichthus, Latr. (*Smerdis*, Leach), has the basal joint of the ocular peduncles short, and the carapax dilated at the sides. Type, *E vitreus*, Latr.

Alima, Leach, has the basal joint of the ocular peduncles much longer, the body much narrower, with the sides of the carapax not dilated. Each of its angles forms a spine, of which the two posterior are the most acute. Type, *A. hyalina*, Latr.

[*Squillericthus*, Edwards, has the claws of the great feet armed with spines.]

THE SECOND FAMILY OF STOMAPODA,—

BIPELTATA, Latr.,—

[Comprises the Glass-Crabs, which] have the carapax divided into two shields, the anterior of which is very large, more or less oval, composing the head, and the second, corresponding with the thorax, is transverse and angulated in its outline, and bears the foot-jaws and the ordinary feet. Those feet, with the exception of the posterior pair, as well as the last pair of foot-jaws, are slender, filiform, and for the most part very long, and accompanied by a lateral, ciliated [short and slender] appendage. The four other [anterior] foot-jaws are very minute and conical. The base of the lateral antennæ is not furnished with a scale, and the intermediate ones are terminated by two filaments. The ocular peduncles are very long. The body is very flat, membranous, and transparent, with the abdomen small, and without spines to the posterior swimmeret. In respect to their nervous system, they appear to be intermediate between the preceding and following Crustacea.

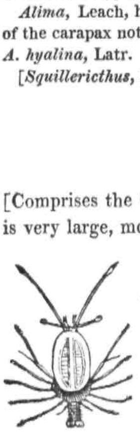

Fig. 10.—Phyllosoma clavicornis.

This family comprises only the single genus *Phyllosoma*, Leach, of which all the species are inhabitants of the Atlantic and Eastern Oceans. [M. Guérin has published a monograph of this genus, with figures of all the species, in his *Magasin de Zoologie*.]

[M. Edwards has recently added another genus, *Amphion*, differing from *Phyllosoma* in its narrower body, and in the carapax extending behind over the whole body, thus rendering Latreille's name, *Bipeltata*, inapplicable.]

Those MALACOSTRACA which have the eyes sessile and immoveable, form the second general subdivision, [and have been collectively named EDRIOPTHALMA by Leach].

The [Branchiopodous genus] *Branchipus* comprises the only Crustacea which remain to be noticed, having the eyes placed on long footstalks; but in them the peduncles are neither articulated nor lodged in cavities expressly for their reception, and they are not only destitute of a carapax, but differ in many other natural characters [from the Podopthalmous Malacostraca].

All the Malacostraca of the present [sub] division are equally destitute of a carapax. The body, following the head, is composed of a series of articulations, of which each of the seven anterior ones is generally provided with a pair of feet, and of which the following and terminal segments (not exceeding seven in number) form a kind of tail, terminated by a swimmeret, or appendages in the shape of styles. The head is furnished with four antennæ, of which the two intermediate ones are superior; two eyes, and a mouth composed of two mandibles, a tongue, two pair of maxillæ, and a sort of lip formed by the two foot-jaws, which correspond with the fourth [or inner] pair in the Decapoda; as in the Stomapoda there is no flagrum. The four outer foot-jaws are transformed into feet, sometimes simple, sometimes terminated in a claw, but almost always with a single finger. According to MM. Audouin and Edwards, the two ganglionated nervous cords are perfectly symmetrical and distinct throughout their entire length, and from the observations of Cuvier the *Onisci* only differ in those cords not presenting the uniformity in all the segments of the body, and that there are fewer

knots. Hence the nervous system of these Crustacea is the most simple of all [yet examined].

The branchiæ appear to be always attached to the two first appendages of the under-side of the abdomen. The female carries her eggs beneath the breast, between certain scales, which form a kind of pouch. They are there hatched, and the young ones remain attached to the legs, or other parts of the body of their parents, until they gain sufficient strength to swim and take care of themselves. These Crustacea are of small size, and reside for the most part either upon the shores of the ocean or in fresh water. Some are terrestrial and others are parasites.

These animals are divisible into three orders: those in which the mandibles are furnished with a palpus, appear to be more nearly allied in nature to the preceding Crustacea—these are the AMPHIPODA. Those in which these organs are destitute of palpi compose the two other orders, LŒMODIPODA and ISOPODA. *Cyamus*, a parasitic genus, belonging to the second of these orders, conducts us naturally to *Bopyrus* and *Cymothoa*, with which we commence the arrangement of the Isopoda.

THE THIRD ORDER OF CRUSTACEA,

[the first of the MALACOSTRACA EDRIOPTHALMA] or the AMPHIPODA,—

Are the only Malacostraca with sessile and fixed eyes, of which the mandibles, as in the preceding Crustacea, are furnished with a palpus, and they are the only order in which the subabdominal appendages, always very apparent, resemble, in their long and narrowed form, their articulations, bifurcations, and the hairs or ciliæ with which they are provided, false legs or swimming fin-feet. In the Malacostraca belonging to the following orders, these appendages have the form of plates or scales, and these hairs or ciliæ appear to constitute the branchiæ. Many exhibit, as well as the Stomapoda and Lœmodipoda, vesicular bags, placed either between their feet or at their base externally, and of which we are ignorant of the uses.

The first pair of legs, or that which corresponds with the second pair of foot-jaws, is always affixed to a distinct segment, being the one immediately behind the head. The antennæ (with the exception of the single genus *Phronima*) are four in number. They are advanced in front and gradually attenuated, terminating in a point, and composed, as in the preceding Crustacea, of a peduncle and a single terminal filament, (or accompanied sometimes by a small lateral branch) and generally multiarticulate. The body is ordinarily compressed, and bent downwards behind. The appendages at the extremity of the tail most frequently resemble small articulated styles. The majority of these Crustacea swim and leap with agility, and always on their sides. Some are found in brooks and fountains, often united in pairs, but the greater number inhabit the salt water. They are of an uniform colour, varying from reddish to green.

Fig. 11.—Gammarus pulex.

They may be comprised in the single genus *Gammarus*, Fab., which may be distributed into three sections, from the form and number of the legs:—

1. Those which have fourteen feet, all of which are terminated by a hook or a point.

2. Those which have also fourteen feet, but in which these organs, or at least the four posterior, are unarmed and merely natatorial.

3. Those which have only ten feet.

The first of these sections [HOMOPODA, Westw.] is divisible into two subsections:—

1. The UROPTERA, Latr., having the head generally large, the antennæ often short, and only two in number in some, and the body soft; all the legs except the fifth pair simple, the anterior short or small, and the tail either furnished at the tip with lateral swimmerets, or terminated by appendages or dilated points, bidentate or forked at the extremity. They reside in the bodies of various *Acalephæ* or *Medusæ*, Linn., and some other zoophytes.

Some, forming the genus *Phronima*, Lat., have only two very short and 2-jointed antennæ. The fifth pair of legs is by far the largest, and terminated by a strong didactyle claw. There are six long slender appendages at the extremity of the body, each terminated by two points. There are probably various species, but which have not been described with sufficient care. Type, *Cancer sedentarius*, Forskal, *Faun. Arab.*, found in the Mediterranean, lodged in a membranous, transparent, bell-like bag, probably the body of a Beroe.

Others have four antennæ; all the legs are single, and the tail is furnished at each side of its extremity with a plate, like a foliaceous swimmeret.

Hyperia, Latr., having the body thickened in front, the head large and almost entirely occupied by two oblong eyes, somewhat notched at the inner margin, two of the antennæ at least half the length of the body, with a terminal multiarticulated filament. Type, *Cancer monoculoides*, Montague, [found on the coast of Devonshire].

Phrosine, Risso, differs in having the antennæ not longer than the head, and but few-jointed, the terminal filament being conical.

Dactylocera, Latr., has the body not thickened in front, the head of moderate size.

Themisto, Guérin, has the third pair of foot-jaws terminated by a small didactyle claw; the third pair of legs is very much longer than the others. [Many additional subgenera have been recently proposed, belonging to the Uroptera, especially by M. Edwards.]

2. The second subsection, GAMMARINÆ, Latr., have always four antennæ, the body covered with a coriaceous elastic tegument, generally compressed and arched; the posterior extremity of the tail is not furnished with swimmerets, but its appendages are in the form of cylindrical or conical styles. Two at least of the four anterior legs are terminated by claws.

The vesicular bags in those species in which they have been observed (*Gammarus*), are situated at the external base of the legs, commencing with the second pair, and accompanied by a small plate. The pectoral scales enclosing the eggs are six in number.

In the majority the four antennæ, although occasionally varying inter se, are applied to the same purposes, and have the same general structure: the inferior never being leg-like.

Ione, Latr., is an anomalous subgenus, founded upon a figure given by Montague, (*Linn. Trans.*, vol. ix. 3, 3, 4.) The body is apparently 15-jointed, the joints being only indicated by lateral incisions; the four antennæ are very short, the external longer than the two others; the two anterior segments of the body are furnished in the female with two elongated fleshy cirrhi, like oars; the legs are very short and hooked; the six terminal segments are provided with lateral, fleshy, elongated, fasciculated appendages, simple in the male but branched in the female. Type, *Oniscus thoracicus*, Montague, found beneath the carapax of *Callianassa subterranea*, forming a tumour on the sides of its body. Montague kept it alive for several days, having removed it from its native abode. The females are always accompanied by the males, which retain themselves firmly attached to the abdominal appendages of their partners by means of their strong hooks. In regard to its habits, therefore, this animal approaches the parasitic Bopyrus.

All the remaining Amphipods have the segments of the body distinct in their entire breadth, and are destitute in both sexes of the long oar-like appendages found in Ione. In some of these the moveable finger of the claw-legs is formed of a single joint.

Orchestia, Leach, and *Talitrus*, Leach [comprising British species] have the upper antennæ much shorter than the inferior, whilst in the following they are not much shorter, [indeed often much longer. The type of the latter genus is *Talitrus locusta*, which is very abundant on our shores, burrowing into the sand, and, unlike the majority of the species, seldom entering the water.] In *Atylus*, Leach, the upper antennæ are nearly as long as the inferior, the head is produced above into a snout, and none of the legs are cheliferous. Type, *A. carinatus*, Leach. The typical genus *Gammarus*, Latr., is distinguished by the isolated character of the superior antennæ, having a short branch at the tip of the third joint, and the four fore-legs are in the form of small claws, with the moveable finger folding on the under-side: *Cancer pulex* is the type. [It is exceedingly abundant in fresh-water brooks, where there is an accumulation of vegetable debris.] Various other genera, as *Melita*, Leach, *Mæra*, Leach, *Amphithoe*, Leach, *Pherusa*, Leach, &c., have been established by Leach and M. Milne Edwards, founded upon variations in their legs and claws.

Leucothoe, Leach, has the moveable finger of the two fore-claws biarticulated. The same character also exists in *Cerapus*, Say, composed of a small species found on the sea-shore of the United States, near Egg harbour, amongst the *Sertulariæ*, and which receives its specific name, *C. tubularis*, from residing in a small cylindrical tube. [Dr. Templeton has described a small species of Crustacea from Mauritius in the *Trans. Entom. Soc.*, vol. i. p. 189, under the name of *Cerapus abditus*, which inhabits a little membranous tube, resembling in texture the papyritious covering of wasps' nests. It is remarkable for wanting feet to the middle segment of its body. Its movements are very singular.]

Podocerus, Leach, and *Iassa*, Leach, have the inferior antennæ greatly elongated in the form, and occasionally assuming the functions of legs and organs of prehension; their second legs are terminated by a large claw.

Corophium, Latr., has similar lower antennæ, but none of the legs are cheliferous. The type is *Cancer grossipes*, Linn., *Gammarus longicornis*, Fab., *Oniscus volutator*, Pal., and which is named *Pernys* on the coast of La Rochelle, living in burrows, which it forms in the sand, covered by hurdles, called *bouchots* by the inhabitants. The animal only makes its appearance at the beginning of May. It keeps up a continual war with the Nereids, Amphinomæ, Arenicolæ, and other marine annelidæ which take up their abode in the same place. Nothing is more curious than to observe these creatures at the rising of the tide assembled in myriads, moving about in all directions, beating the mud with their arm-like antennæ, and diluting it in order to discover their prey. If they discover any of these annelidæ, often ten or even twenty times larger than themselves, they unite together to attack and devour it. The carnage never ceases until the mud has been turned over and examined. They also attack fishes, mollusca, and dead bodies on the shore. They mount upon the hurdles which contain muscles, as well as upon the latter, and the fishermen pretend that they cut the threads which retain the muscles, in order to cause the latter to fall, so that they may be the more readily devoured. They appear to breed throughout the season, as the females are found carrying eggs at different times: shore-birds and many kinds of fishes devour them.

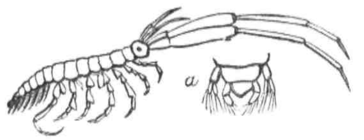

Fig. 12.—Corophium longicorne; *a*, terminal segment of the tail.

The second of the sections of the order *Amphipoda*, or the Heteropa, Lat., is composed of those which have fourteen legs, the four posterior at least being unarmed at the tip, and fit only for swimming,* and forms two subgenera.

Pterygoura, Latr., has the thorax divided into numerous segments, four antennæ, with long hairs; all the legs natatorial, and of which the posterior are large and pennated. [Type, *Oniscus arenarius*, Slabber.]

Apseudes, Leach (*Eupheus*, Risso), has the thorax divided into numerous segments, the fore pair of legs terminated by a large claw, the second pair of legs with the terminal joints very broad and toothed [whence the specific name of the type, *A. talpa*, Leach, Montague, from its analogy with the Mole]; the other legs are single, the body is long and narrow, terminated by two long threads.

Rhœa, Edwards, differs from the preceding in having the superior antennæ thicker, longer, and bifid.

The third and last section of the order *Amphipoda*, or the Decempoda, Lat., consists of species having only ten feet.

Typhis, Risso, has only two antennæ; the head is large, with prominent eyes; each pair of legs is attached to a distinct segment; the four anterior are terminated by a didactyle claw. On each side of the thorax are two moveable plates, forming two valves, beneath which, when at rest, the animal shuts its legs and tail, giving it the appearance of a ball. Type, *Typhis ovoides*, Risso.

Anceus, Risso, *Gnathia*, Leach, has the thorax divided into the same number of segments as there are pairs of legs, which are simple and monodactyle. They have four antennæ; the head is large and square, and furnished in front with two great projections, like mandibles. Type, *Cancer maxillaris*, Montague, *Trans. Linn. Soc.*, vol. vii. pl. 6, f. 2,—found on the Devonshire coast.

Praniza, Leach, has four antennæ like the last, but the thorax from above presents only three segments, of which the two anterior are very short, and the third very large and oval, having the three posterior pairs of legs attached to it. The legs simple, the head triangular, and the tail furnished at the sides of the extremity with a swimmeret. [I have investigated the structure of this curious genus very minutely, and published the result thereof in the *Annales des Sciences Naturelles*, vol. xxvii.]

To this order also appear to belong various other genera, established by Savigny, Rafinesque, and Say, but of which the characters have not been hitherto given with sufficient decision; and even of those cited above some require a re-examination.

M. Milne Edwards has collected many valuable and detailed observations on many of these Crustacea, which will serve to clear up much of this obscurity. I am not able to speak with precision also of the genus *Ergina* of Risso. From the number of legs it appears to belong to the last section of the Amphipoda, but the manner in which they terminate, and the number of the segments of the body, range them amongst the Isopods.

[Since the publication of the second edition of this work, the Amphipoda have received a considerable share of attention. M. Milne Edwards, in the *Annales des Sciences Naturelles* for 1830, published a revision of the order, dividing it into two principal groups, (removing the genera Rhœa and Tanais to

* This and the following section formed, in the first edition of this work, the second of the Isopodous order, that of Phytibranches. But not only have we perceived mandibular palpi in some of these Crustacea, but also the form of the subabdominal appendages has appeared to us to approximate them to the Amphipoda, and not the Isopoda. Nevertheless, these animals, of which the number is but very small, have been very imperfectly studied.

the order Isopoda), namely, the Crevettines and the Hyperines, the former divided into the saltatorial and ambulatory species. Some new genera were added, especially in the singular family of the Hyperines. *Pterygocera*, Latr., and some other genera, he considers not sufficiently studied, and consequently of doubtful character and situation. *Apseudes*, *Ione*, *Anceus*, and *Praniza*, he also regards as isopodous. Various additional genera have also been established by M. Guérin de Meneville, in the *Magasin de Zoologie*, especially amongst the Hyperines, and which are accompanied by figures and generic details. Dr. Templeton has described some curious minute species from Mauritius, in the *Transactions of the Entomological Society*. Still more recently I have received from M. Kroyer, the Danish naturalist, a memoir upon the Amphipoda of Greenland, published in the last part of the *Copenhagen Transactions*. Rathke has described many new species, and some new genera from the Caspian Sea, in the last volume of the *Petersburg Memoirs*, and Professor Owen has described some interesting species brought home in one of the late Polar expeditions. One of the most remarkable of the subgenera established, is that of *Orio* of A. Cocco, described in the *Giornali di Scienze, &c., per la Sicilia*, for November 1833, which has been overlooked by Crustaceologists, and in which the maxillary palpi are exceedingly slender, as long as the body, and 4-jointed.]

THE FOURTH ORDER OF CRUSTACEA,

LŒMODIPODA,—

Comprises the only Malacostraca with sessile eyes which have not distinct branchiæ attached at the extremity of the body, which are nearly destitute of a tail, the hind pair of legs being attached either at the extremity of the body or to a segment, followed by one or two very small joints. They are also the only species in which the two fore-legs, which correspond with the second foot-jaws, form part of the head.

All the species have four setaceous antennæ, implanted on a peduncle of three joints; mandibles destitute of palpi; a vesicular body at the base of at least four of the pairs of legs, commencing with the second or third pair, including those of the head. The body, generally filiform or linear, is composed (including the head) of eight or nine segments, with several small appendages in the form of tubercles at its posterior and inferior extremity. The legs are terminated by a strong hook; the four anterior, of which the second pair is the largest, are always terminated by a monodactyle claw. In some, the four following are more slender, with fewer articulations, without a terminal hook, or are rudimental and in no manner fitted for the ordinary uses.

The females carry their eggs beneath the second and third segments of the body, in a pouch formed of scales closely applied against each other.

All these Crustacea are marine. M. Savigny considers them as approaching the Pycnogonides, and as forming, together with them, the passage between the Crustacea and Arachnida. In the first edition of this work, they formed part of the Isopodous order, namely, the section Cystibranchiæ.

They may be considered as forming a single genus, for which, on account of its priority, the name of

CYAMUS (Latr.)—

should be retained.

Some of these (forming a first section named *Filiformia*, Latr.) have the body long and very slender or linear, with the segments longitudinal; the legs also long and very slender, and the terminal filament of the antennæ composed of minute joints.

They are found amongst marine plants, creeping along in the same way as the Geometer or Looper-caterpillars, bending themselves often back with great rapidity, and applying their antennæ to various parts of the body. In swimming they bend the two ends of the body downwards.

Leptomera, Latr. (*Proto*, Leach), has fourteen complete legs (including the pair attached to the head), forming a regular series. In some of them (as in *Gammarus pedatus*, Müller, forming the type of the restricted genus *Leptomera*) all the legs (except the two anterior) are furnished with a basal vesicle, whilst in the others (*Cancer pedatus*, Montague, being the type of Leach's *Proto*) these appendages exist only at the base of the second and four following legs.

Naupredia, Latr., has ten legs in a continuous series, the second and two following pairs having a vesicular body at the base. The typical species found on the French coast appears to me to be undescribed.

Caprella, Lamarck, have also only ten legs, but the series is interrupted; the second and following segments being destitute of legs, but each is furnished with two vesicular bodies. Type, *Squilla lobata*, Müller.

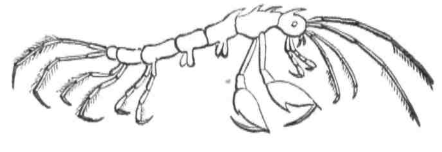

Fig. 13.—Caprella phasma.

[Dr. Johnston has published a monograph of the British species of this section in the eighth volume of the *Magazine of Natural History*, and Dr. Templeton and M. Guérin have respectively described various additional species of this curious group.]

The other Lœmodipoda, forming a second section (OVALIA, Latr.), have the body oval, with the segments transverse; the terminal filament of the antennæ appears to be inarticulated. The legs are short, or of only moderate length; those of the second and third segments are imperfect, and terminated by a long cylindrical joint without terminal hooks; they have at the base an elongated vesicular body. These Lœmodipoda form the subgenus—

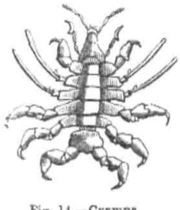

Fig. 14.—Cyamus Balænarum.

Cyamus, Latr. (*Larunda*, Leach), of which I have seen three species, all of which live upon Cetacea, and of which the commonest (*Oniscus Ceti*, Linn.) is also found upon the Mackerel. The fishermen call it the whale-louse. Another species, closely allied, was brought home by Delalande, in his voyage to the Cape of Good Hope. The third, which is much smaller, is found upon the Cetacea of the Indian seas.

[M. Roussel de Vauzème has published a very complete and interesting memoir upon this singular genus in the *Annales des Sciences Naturelles* for May, 1834, describing three species living upon Whales of the Southern Ocean, and also observed their respective habits. Sometimes these creatures are so abundant on the Whales that the individuals they infest may be easily recognized at a considerable distance by the white colour these parasites impart to them. When removed, the surface of the body of the Whale is found to be deprived of its epidermis. *C. ovalis* and *gracilis* are stationary, being found in great numbers agglomerated upon the corneous prominences of *Balæna mysticetus*. *C. erraticus* is, however, organized for its wandering habits, being of a slender form, and with larger legs, serving for prehension. The young ones appear with all the characters of their kind, only the head is rather large, and the supposed branchial appendages, instead of being long and slender, are short and somewhat globose.]

THE FIFTH ORDER OF CRUSTACEA,

ISOPODA,—

Or the Polygonata of Fabricius, (after the removal of the genus Monoculus) is allied to the Lœmodipoda in the absence of palpi to the mandibles, but is separated from them in other respects. The two fore-legs are not attached to the head, but to a distinct segment, as are the following feet. These limbs are always fourteen in number, hooked at the tip, without any vesicular appendage at the base. The under-side of the tail is furnished with very distinct appendages, in the form of plates or vesicular bags, of which the two anterior and exterior ordinarily cover, either entirely or for the most part, the others. The body is generally flattened, or broader than deep. The mouth is composed of the same pieces as in the preceding; (see the general remarks on the Malacostraca); but here, those which correspond with the two superior foot-jaws of the Decapods present, even more strongly than in those Crustacea, the appearance of a lower lip, terminated by two palpi. The intermediate pair of antennæ is obsolete in the terminal species in the order, which are terrestrial in their habits, and which [consequently] differ from the rest in respect to their respiratory apparatus.

M. V Audouin and M. Edwards have given (*Ann. des Sciences Nat.*, 1827) some interesting

observations on the circulation of the Isopoda, and especially in the Ligiæ. The heart has the form of a long vessel, extended above the dorsal face of the intestine; from its anterior extremity are emitted three arteries, as in the Decapods, but from their examination it would seem that the venous system is not so complete as in the Macroura. In respect to the nervous system, there are nine ganglions, not including the brain, but the two anterior and the two posterior are so nearly together that they may be reduced to seven. The second and six following send forth nerves to the legs, and the tail is furnished with nerves from the last ganglion.

The females carry their eggs underneath the breast, either defended by scales, or in a pouch or membranous sac, which they open in order to allow the young ones to escape; these are born with the form and parts peculiar to their own species, and merely increase in size by changing their skins. [M. Milne Edwards, in his interesting "*Observations sur les changemens de forme que divers Crustacés éprouvent dans le jeune âge*," (published in the *Annales des Sciences Naturelles,*) has given a detailed account of the peculiarities which distinguished the young individuals of *Cymothoa trigonocephala* and *Anilocra mediterranea,* which had been extracted from between the pectoral plates of the females. In the newly-hatched young, the tail is longer and narrower than in the perfect animal, and it has only six thoracic segments and six pair of legs.]

The greatest number of the species reside in water. Those which are terrestrial have likewise need, as is the case with other Crustacea living out of the water, of a certain degree of atmospheric humidity, in order to enable them to respire, and keep their branchiæ in a state fitted for that function.

This order, in the system of Linnæus, consists of the genus

ONISCUS,—

which we distribute into six sections.

The first section, EPICARDES, Latr., is composed of parasitic Isopods having neither eyes nor antennæ, of which the body is very flat, small, and oblong in the males, but much larger in the females, of an oval form, narrow and rather bent posteriorly, concave beneath, with a thoracic rim, divided on each side into five membranous lobes, the legs being inserted on this rim, very small and bent round, and fit neither for crawling nor swimming; the under-side of the tail is furnished with five pairs of small ciliated imbricated plates, answering to the same number of segments, and arranged into two longitudinal rows, but the posterior extremity of the body is not furnished with appendages. The mouth only distinctly exhibits two membranous plates, applied upon another of the same consistence, being of a quadrilateral form. The hollowed part of the body is filled with eggs, and near the situation where they are discharged the presumed males are constantly found, but their exceedingly minute size seems to render the act of coupling impossible. These Crustacea form only a single subgenus,—

Bopyrus, Latr., the common and typical species of which is the *Bopyrus crangorum*, Fab., which is parasitic upon the Common Prawns, *Palæmon squilla* and *serratus*, affixing itself beneath the carapax, upon the branchiæ, when it produces on the side of the body attacked a tumour or swelling like a lens. The fishermen of La Manche believe that these parasites are young soles, [to which fish they bear a slight resemblance in form].

M. Risso has described a second species [*B. Palemonis*, Risso, *Crust. Nice.* p. 148], beneath the body of the female of which he observed between eight and nine hundred minute young ones, [easily visible with a lens, of a greyish white colour, and which the parent has always the instinct to deposit in the places frequented by the Palæmons; and as soon as the young are free they attach themselves to their prey].

The second section, CYMOTHOADA, Latr., comprises those Isopoda which have four distinct antennæ, setaceous, and ordinarily terminated by a multiarticulate filament, having eyes and a mouth composed of the ordinary parts (see the general observations upon the Malacostraca Edriopthalma), and vesicular branchiæ disposed longitudinally in pairs. The tail is composed of four or six segments, with a swimming plate on each side near the tip, and the five legs are generally terminated by a strong hook or claw. All the *Cymothoada* are parasites.

In *Serolis*, Leach, the eyes are placed upon tubercles on the back of the head, and the tail is composed of only four segments. The antennæ are arranged in two lines, and terminated by a multiarticulate filament. Beneath the three basal segments of the tail, between the ordinary appendages, there are three others, transverse, and terminated posteriorly in a point. One species was only known to Latreille, namely, the *Cymothoa parado*r

This extraordinary genus has been considered as affording proof of the relation of the Trilobites to the Isopodous Crustacea, the body being divided into three longitudinal portions, as in those fossils. The genus has lately been described and figured in detail by Eights, under the name of *Brongniartia Trilobitoides*, in the *Transactions of the Albany Institute.*]

In the other *Cymothoada* the eyes are lateral, and not placed upon tubercles, and the tail is composed of four or six joints; of these the majority have the eyes not formed of granular ocelli; the antennæ are at least seven-jointed, and the six fore-legs terminated by a strong hook; of these the following subgenera have the tail always six-jointed, and the lower antennæ never exceed in length half of the body.

Cymothoa, Fab., having the mandibles not exposed, the antennæ of nearly equal length, the eyes slightly apparent, and the terminal joint of the tail transverse-quadrate. Type, *Cymothoa Œstrum*, Fab. [These animals were well known to the ancients, who gave them the name of *Œstrus* and *Asilus*, from the resemblance between their habits and those of the breeze-flies. Aristotle says of the species above mentioned, " Fishes are attacked by a sea-louse, which is not produced from the fish but from the mud."]

Ichthyophilus, Latr. (*Nerocila* and *Lironeca*, Leach,) differs from the last in having the terminal segment of the tail nearly triangular. To these succeed various subgenera, instituted by Leach upon structural characters, such as the relative length of the antennæ, form of the swimming plates of the tail, &c.

In *Œga*, and several others, the eyes are generally large, and converge anteriorly.

Synodus, Latr., having also six segments to the tail, differs from all the preceding in the large size of its exserted mandibles.

Cirolana, Leach, and several others, have only five segments in the tail, and the length of the inferior antennæ is greater than that of half the body.

Eurydice, Leach, belonging to this division, naturally conducts us in the granular structure of its eyes to

Limnoria, Leach, in which these organs resemble numerous ocelli, placed close together, which have the antennæ inserted in a line, and not composed of more than four joints, and all the legs are formed for walking. The tail is 6-jointed, the terminal joint being large and suborbicular. The only known (recent) species is the *L. terebrans*, Leach, which, although not more than a sixth of an inch in length, is, in its powers of multiplication, exceedingly destructive. It pierces the wood of vessels in different directions with astonishing alacrity, and contracts itself into a ball when alarmed. It is found in different parts of the British Ocean, [attacking piles of wood immersed in the water in our dockyards, flood-gates, timber-bridges, chain-piers, &c., and which it perforates in a most alarming manner. The boring of the insect having for its object the procuring of food, the contents of its stomach resemble comminuted wood. It is necessary that the hole in which it is at work should be filled with salt water. Coating the wood with copper-headed nails, and the use of Kyanized wood, have been suggested as remedies against its attacks].

Professor Germar forwarded to Dejean the figure and description of a small fossil crustaceous animal, which appears to us to belong to this subgenus.

The third section, SPHÆROMIDES, Latr., exhibits four distinct and setaceous or conical antennæ, terminated (except in *Anthura*) by a multiarticulate filament: the lower pair is always the longest, and inserted beneath the basal joint of the upper, which is thick and broad. The mouth is of the ordinary form. The branchiæ are vesicular or soft, naked, and disposed longitudinally in pairs. The tail is only composed of two complete and moveable segments, the first of which, however, exhibits impressed and transverse lines, indicating the vestiges of the same number of segments. On each side of the posterior extremity of the body is a swimmeret, terminated by two plates, of which the inferior alone is moveable, and the upper is formed by an external elongation of the common support. The branchial appendages are curved inwards; the inner side of the anterior pair is accompanied in the males with a small linear and elongated piece. The anterior part of the head, situated beneath the antennæ, is triangular, or in the shape of a heart reversed. The majority have the body oval or oblong, assuming the form of a ball when contracted.

Zuzara, Leach (with very large swimmerets), and *Sphæroma*, Latr. (with moderate sized-swimmerets), have the impressed lines on the basal segments of the tail not extended to the sides. In the following they extend to the margin, forming as many incisions, and the basal joint of the antennæ forms a long square or linear plate.

Næsa and *Campecopæa*, Leach, have the sixth segment of the body considerably longer than the preceding, whilst it is of equal size in

Cilicæa, Leach, *Cymodocea*, Leach, and *Dynamene*, Leach, distinguished by variations in the form of the swimmeret and the sixth segment of the body.

Anthura, Leach, differs from all the preceding in its vermiform body, and in having the antennæ scarcely as long as the head, and 4-jointed. The plates of the swimmeret form a kind of capsule. (*Oniscus gracilis*, Montague.)

In the fourth section, IDOTEIDES, Leach, the antennæ are also four in number, but placed in the same transverse and horizontal line; the lateral ones are terminated by a multiarticulate and gradually attenuated filament, the intermediate short, filiform, or slightly thickened at the tip, and 4-jointed, none of the joints being articulated. The mouth is composed of the same parts as in the preceding.

The branchiæ are in the form of bladders, white in the majority, capable of being puffed up and used in swimming, and covered by two plates or valves of the last segment, laterally adherent to its sides, longitudinal, biarticulate, opening in the middle in a straight line, like a pair of cupboard doors. The tail is formed of three segments, of which the last is the largest, with neither appendages nor lateral swimmerets. All these Crustacea are marine.

Idotea, Fab., have the legs strongly hooked, and all of the same form, and the lateral antennæ are shorter than half the body. (*Oniscus Entomon*, Linn.)

Stenosoma, Leach, has the body linear [and depressed], and the [lateral] antennæ nearly equal to the body in length. (*Stenosoma lineare*, Leach.)

Arcturus, Latr., is very remarkable in the form of the second and third pairs of legs, which are directed forward, and terminated by a long hirsute joint, and unarmed or feebly-hooked: the two anterior are applied to the mouth; the six posterior legs are long, formed for walking, directed backwards, and bifid at the tip. In the length of the antennæ and form of the body they approach *Stenosoma*. I have only seen one species (*A. tuberculatus*), brought from the North Seas in one of the late English expeditions to the Arctic Pole. [This species was published by Sabine under the name of *Idotea Baffini*, but a second species exists in the north of our coast, which I have described in detail, with figures, in the first volume of the Transactions of the Entomological Society, under the name of *Arcturus longicornis*.]

The fifth section, ASELLOTA, Latr., is also formed of Isopods, having four very distinct antennæ arranged in two lines; they are setaceous, and terminated by a multiarticulate filament, two mandibles, four maxillæ, covered in general by a kind of lip formed of the first pair of foot-jaws; vesicular branchiæ disposed in pairs, and covered by two longitudinal, biarticulated, but free plates: the tail is formed of a single segment, and without lateral swimmerets, but with two bifid styles, or two very short appendages in the form of tubercles in the middle of the posterior margin.

Asellus, Geoffroy, has two bifid styles at the extremity of the body, the eyes distinct, the superior antennæ as long as the basal joint of the inferior, and the hooks at the tips of the legs entire. The only species of this genus is the *Idotea aquatica*, Fab. (*Squilla asellus*, De Geer), which is very abundant in fresh and stagnant water. It crawls slowly, at least, when not alarmed. In the spring it creeps out of the mud in which it had buried itself during the winter. After impregnation the female carries her eggs, in great numbers, inclosed in a membranous sac, placed beneath the breast, and opening by a longitudinal slit, in order to allow the young ones to escape.

Oniscoda, Latr. (*Ianira*, Leach) have the eyes contiguous, and the hooks of the tarsi bifid at the tips. (*Ianira maculosa*, Leach, found on the coast of England amongst the sea-weeds.)

Iæra, Leach, has only two tubercles at the extremity of the body. (*I. albifrons*, Leach, also found on the coast of England.)

The sixth and last section of the order *Isopoda*, or the ONISCIDES, Latr., have also four antennæ, but the intermediate pair is so minute as to be scarcely apparent, and never consists of more than two joints; the lateral are setaceous. The tail is composed of six segments, with two or four style-like appendages at the posterior margin of the hind segment, and destitute of lateral swimmerets: some species are aquatic, but others are terrestrial. In the latter the anterior plates of the under-side of the tail exhibit a row of small holes, through which the air penetrates, and is brought into contact with the respiratory organs, which are inclosed beneath.

Some of these are marine, and have more than nine joints in the antennæ, (including the terminal annuli).

Tylos, Latr., appears to have the power of rolling itself into a ball; the posterior segment is semicircular, and exactly fits the incision made by the preceding; the posterior appendages are very minute; the antennæ have only nine joints.

Ligia, Fab., have the terminal annuli of the antennæ very numerous, and the body is terminated by two styles, divided at the tip into two branches.

The type, *Oniscus oceanicus*, Linn., is about an inch long, of a gray colour, with two large yellow patches on the back. The lateral antennæ are about half the length of the body, the terminal filament being composed of thirteen joints. The terminal styles are as long as the tail itself. It is very common on the coast, clinging to the rocks and to the parapets of maritime erections. When it is attempted to be seized it immediately folds up its legs, and drops. Another species, *Oniscus hypnorum*, Fab., has the terminal division of the antennæ 10-jointed, and the basal part of the anal styles armed with a tooth on the inside.

The other *Oniscides* are terrestrial, and the lateral antennæ have not more than eight joints, of which the proportions towards the extremity gradually diminish, none of them appearing to be divided into annuli.

Philoscia, Latr., has the lateral antennæ 8-jointed, and exposed at the base; the four exterior posterior appendages are nearly equal. They are always found in moist situations. (*Oniscus sylvestris*, Fab.; *O. muscorum*, Cuv.)

Oniscus, proper, Linn., have also 8-jointed lateral antennæ, but the base is concealed, and the two outer appendages at the tip of the tail are larger than the two internal. The animals of this and the two following genera are called wood-lice, St. Anthony's hogs, &c. They frequent dark and concealed places, such as cellars, caves

holes in walls, under stones, &c. They feed upon decaying vegetable and animal matter, and only come forth from their retreat in wet and moist weather. They crawl but slowly, at least, when not alarmed. The eggs are inclosed in a pectoral pouch. The young, when first hatched, are destitute of one of the thoracic segments, and consequently of a pair of legs, which they subsequently acquire. They were formerly much used in medicine, but their employment has long been discontinued. (Types, *Oniscus murarius*, Fab.; *Cloporte ordinaire*, Geoff.; *Cloporte aselle*, De Geer.)

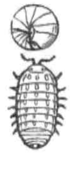

Fig. 15.—Armadillo pustulatus.

Porcellio, Latr., differs from Oniscus in having only seven joints in the lateral antennæ. (*Oniscus asellus*, Cuv.)

Armadillo, Latr., differs from all the preceding in the posterior appendages of the body not being exserted. The last segment is triangular. The lateral antennæ have only seven joints, the upper sub-abdominal plates have a row of small apertures. (*Oniscus armadillo*, Linn.; *O. cinereus*, Panzer—*Armadillo pustulatus*, Desm.—*Armadillo officinalis*, Dumeril, from Italy, a species formerly much employed by the apothecaries.)

SECOND GENERAL DIVISION.

CRUSTACEA ENTOMOSTRACA (Müller).

Under this denomination, formed from the Greek, and signifying insects in a shell, Otho Frederick Müller comprised the genus Monoculus of Linnæus, to which some of his Lernææ must also be added. The researches of Müller upon these animals, of which the investigation is rendered the more difficult owing to their general microscopical size, together with those of Schäffer and the elder Jurine, have excited the admiration, and merit the thanks, of all naturalists. Other works, but of a more partial nature, as those of Ramdohr, Strauss, the younger Hermann, the younger Jurine, Adolphe Brongniart, Victor Audouin, and Milne Edwards, [to which we may add the more recent memoirs of Dr. Loven in Sweden, of Dr. Johnston and William Baird in our own country, and of Dana in America], have greatly extended our acquaintance with these animals, especially in respect to their anatomy. M. Strauss far surpasses the others, although forestalled, as well as the elder Jurine, in various important structural observations, by Ramdohr, whose memoir upon Monoculus, published in 1805, appears to have been unknown to those authors. Fabricius contents himself with adopting the genus Limulus of Müller, which he places in his class Kleistagnatha, or our Brachyurous Decapoda. All the rest of the Entomostraca he reunites, after Linnæus, in a single genus Monoculus, placed in his class Polygonata, or our Isopodous Edriopthalma.

All these animals are aquatic, and ordinarily inhabit fresh water. Their legs, of which the number is variable—reaching, in some species, to beyond a hundred—are generally fitted only for swimming, and are sometimes ramified or divided, sometimes ornamented with long feathered hairs, or composed of plate-like joints. Their nervous system is composed of only one or two globules. The heart has also the form of a long vessel. Their branchiæ, composed of hairs or threads, either isolated or united, so as to form beards, combs, or tufts, form part of the legs, or at least of a certain number of them, as well as, occasionally, of the mandibles and upper maxillæ. (See *Cypris*.) Hence the origin of the name Branchiopoda, which we applied to these animals, and which we at first united into a single order.

Nearly all the species have a shell of one or two pieces, of very slender consistence, and generally nearly membranous and almost diaphanous, or at least they have a large anterior thoracic segment, often soldered with the head, and appearing to occupy the

situation of the shell. The teguments of the body are ordinarily corneous rather than calcareous, in which respect these animals approach the Insecta and Arachnida. In those which are furnished with ordinary maxillæ, the inferior or exterior are always naked; all the foot-jaws performing the office of legs, properly so called, none of them being applied to the mouth. The second maxillæ, except in the Phyllopoda, also resemble these last-named organs. By Jurine, they are sometimes called hands.

These characters distinguish the masticating Entomostraca from the Malacostraca. The other Entomostraca, or those which compose our order Pœcilopoda, cannot be confounded with the Malacostraca, being destitute of organs fitted for mastication, or because the organs which appear to serve as maxillæ are not inserted close together anteriorly, and preceded by an upper lip, as in the preceding Crustacea and the mandibulated insects, but merely formed by the coxæ of the locomotive organs, which are armed for this purpose with small spines. The Pœcilopoda represent, in this class, those species which, amongst the Insects, are distinguished by the name of Haustellata. They are almost exclusively parasitic, and appear to conduct us insensibly to the Lernææ; but the presence of eyes, the power of changing the skin, or even of undergoing a kind of metamorphosis*, with the capability of transporting themselves from place to place by the help of the legs, appear to us to establish a positive line of demarcation between these animals and the parasitic Lernææ. We have consulted, in respect to these transformations, various learned naturalists who have frequently observed the Lernææ, and none of them have ever observed the change of skin.

The antennæ of the Entomostraca vary, both in form and number, considerably; and in some species are employed as organs for swimming. The eyes are very rarely fixed upon a footstalk; and even when this is the case, the peduncle is merely a lateral prolongation of the head, and is never articulated at its base. Often the eyes are placed close together, and sometimes even become confluent, so as to exhibit but one eye. The organs of generation are placed at the base of the tail: it is a mistaken notion which has been entertained, that the antennæ in some males perform this function. The tail† is never terminated by a fan-shaped swimmeret, and is never furnished with the false feet which are seen to exist in the Malacostraca. The eggs are arranged in a mass beneath the back [of the shell], or are exterior, contained in a common envelope, having the appearance of one or two minute bunches of grapes, situated at the base of the tail. It appears that they are able to remain for a great length of time in a dry state, without losing their properties. It is not until after the third moulting that these animals become adult, and capable of reproduction; and it has been observed, in respect of some of them, that a single copulation is sufficient to fecundate many succeeding generations.

[By referring to pages 409 and 410, the distributions into orders, &c. of the Entomostraca, as proposed by Latreille, Milne Edwards, &c., will be perceived to vary somewhat inter se. The question as to the *rank* of the different groups, subsequently described either as orders or minor divisions, cannot be decided until naturalists are agreed as to the relative importance of the organs upon the variations of which these different classifications have been proposed. The following is of course that of the

* The young of the Daphniæ, and of some allied subgenera, such, especially, as Cypris and Cythere, do not differ, or but very slightly, from their parents in other respects than that of size, even at the period of bursting from the eggs. Those, however, of Cyclops, the Phyllopoda, and Argulus, are subject, in their earlier life, to evident changes, either in the form of the body or the number of legs. These organs also undergo changes in some species which entirely alter their uses.

† With the exception of the Phyllopoda, the posterior legs are thoracic, or are foot-jaws. (Cypris.)

Règne Animal, although Latreille himself, as stated in p. 410, in his more recent work, had raised some of those groups, subsequently described, to the rank of orders.]

THE FIRST ORDER OF ENTOMOSTRACA,—

(*The Sixth of the Class* CRUSTACEA),—

BRANCHIOPODA,—

Has, for its characters, a mouth composed of an upper lip, two mandibles, a tongue, and one or two pairs of maxillæ; and the branchiæ, or the first of these organs when there are many, always anterior.

These Crustacea are always wandering about, generally covered by a shell in the form of a shield, or bivalve case, and provided with two or four antennæ. The legs, except in a few, are only fitted for swimming: they are variable in their numbers, there being only six in some, but in others there are from twenty to forty-two, or even more than a hundred. Many exhibit only one eye.

These Crustacea being for the most part microscopical, it will be perceived that the application of one of the characters of which we have made use—namely, that of the presence or absence of mandibular palpi—will here present nearly insurmountable difficulties.* The form, and the number of the legs and eyes, the shell and the antennæ, will furnish characters of more ready application, and capable of being examined by every inquirer.

The order of Branchiopoda composed, in the methods of De Geer, Fabricius, and Linnæus [with the exception of a single species, *M. polyphemus*], the single genus,

MONOCULUS (Linn.),†—

Which we separate into two principal sections: 1. LOPHYROPA, divisible into three subsections, *Carcinoida, Ostracoda,* and *Cladocera;* and, 2. PHYLLOPA, divisible into two subsections, *Ceratopthalma* and *Aspidiphora.*

The first section of the *Branchiopoda*—that of the LOPHYROPA—is distinguished by the number of the legs, which never exceeds ten, and of which the joints are cylindrical or conical, and never entirely lamelliform or foliaceous. The branchiæ are few in number, and the majority have only one eye. Many, also, have the mandibles furnished with a palpus. The antennæ are generally four in number, and are used in locomotion.‡

We divide the Lophyropa into three principal and very natural divisions, and of which the two first agree with the preceding Crustacea in their palpigerous mandibles, and some other characters.

The first division of the Lophyropous Branchiopoda, or that of the CARCINOIDA, Latr., has the shell more or less ovoid, or oval, not shutting in two parts in the manner of a bivalve shell, but leaving the lower part of the body naked. Their antennæ have never the appearance of branching arms. The legs are ten in number, and more or less cylindrical, or setaceous. The females in those species whose gestation has been observed, carry their eggs in two external sacs situated at the base of the tail. Some of them have two distinct eyes, and form a first subdivision.

Those species which have the thorax entirely covered by the shell, with the eyes large, and the intermediate antennæ terminated by two filaments, compose the two following genera.

* We nevertheless arrange, at the head, all those Branchiopoda which have the mandibles furnished with palpi. They compose the two first divisions of the Lophyropa.

† Together with that of Binoculus of Geoffroy.

‡ Strauss appears to attribute this character exclusively to Cypris and Cythere; but from the observations of the elder Jurine and Ramdohr, it exists also in Cyclops.

Zoea, Bosc, having the eyes large, globular, and entirely uncovered, with the thorax cornuted. *Z. Pelagica*, Bosc, found in the Atlantic Ocean; *Monoculus Taurus* of Slabber; and probably the *Cancer Germanus* of Linnæus. [These curious creatures, of which Latreille observed that they had not been sufficiently studied, and at the same time regretted that he had never been able to obtain a specimen, have recently attracted a great deal of attention, from having been asserted to be merely the larvæ of Decapod Brachyurous Crustacea, such as the common edible Crab, &c., by Dr. J. V. Thompson, who, in his *Zoological Researches*, and other memoirs published in the different scientific periodicals, has given figures of many new species, without, however, gaining a knowledge of the perfect analogy which exists between the organs of these animals and the Macroura. Having fortunately been enabled to dissect a very large species of this singular group, I have ascertained that the supposed legs are merely the two outer pairs of foot-jaws immensely developed; the five pairs of true thoracic legs existing beneath the carapax. (See my memoir, published in the *Philosophical Transactions*.) M. Milne Edwards treats of them as *Crustacés douteux*, and thinks it possible that they may be the young of some of his Anomourous order. In this state of the question (the change from a Zoea to a Crab never having been observed, although the genera *Megalopus* and *Macropa* of Latreille are affirmed to be the intermediate stage), all that can with certainty be arrived at is, that Zoea is a Malacostracous animal, belonging to the order Decapoda, and that it must consequently be removed from the Entomostraca.]

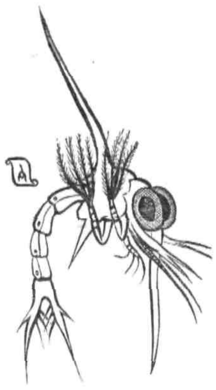

Fig. 16.—Zoea.

Nebalia, Leach, has the eyes flattened, and in part covered by a triangular channelled scale. The legs are furcate; and the appendages at the extremity of the body setaceous. *N. Herbstii*, Leach and Desmarest; and *N. Geoffroyi*, Edwards. The latter is described, in a very detailed manner, by M. Milne Edwards, in the *Annales des Sciences Naturelles*, [vol. xiii. pl. 15]. The rostrum in front of the shell is articulated at its base. The eyes are peduncled: the superior antennæ are inserted beneath them, with the second joint furnished with an oval ciliated plate. [The terminal part is 9-annulated: these organs are elbowed, and bent down in front. The inferior antennæ are longer, more slender, and equally directed downwards: they consist of four strong basal joints, and nine long terminal annuli. The shell is oval, and the animal considerably resembles a small short Shrimp, only the legs are very short, bifid, and inserted far behind. Between them and the mouth, there are, however, five pairs of minute, lamellose appendages, which probably represent the hinder foot-jaws and the fore-legs. The abdomen is long, slender, nine-jointed, and terminated by two bifid appendages.]

The *Nebalie ventrue* of Risso (*Journ. Phys.*, Oct. 1822) probably constitutes a distinct genus in the section of the Schizopoda. In the *Cyclops exiliens* of Viviani, the thorax is divided into several segments, which excludes it from *Nebalia*. It also forms a subgenus intermediate between the preceding and following.

Cuma, Edwards, is allied to *Condylura*, but the superior antennæ are rudimental, and consist of a single joint. The head is distinct from the thorax, which is divided into four segments, of which the first supports the four fore-legs, and each of the three following another pair. All the legs are natatory, directed forwards, and without hooks at the tip. The two first pairs are alone bifid. [M. Edwards placed it amongst the Amphipoda. The *Cancer scorpioides* of Montague, overlooked by all Crustaceologists, appears to be congenerous. Type, *Cuma Audouinii*, Edwards.]

Condylura, Latr. The inferior antennæ are longer. The anterior sides of the first segment are prolonged and pointed, forming two scales close together like a beak. Some of the middle feet are furnished, like the Schizopods, with an outer appendage close to the base. The tail is narrow, 7-jointed, the last being long, conical, and extends between the two slender, styliform, 2-jointed lateral appendages. *C. Dorbignii*, Latr. From the coast of La Rochelle.*

The other *Lophyropa* of the first division, and in which the thorax is divided into several segments, the first being by far the largest, are only furnished with a single eye, situated in the middle of the forehead between the upper antennæ, constituting the genus

Cyclops, Müll., studied by the elder Jurine and Ramdohr. The body is more or less oval, soft, or gelatinous, divided into two portions; the one anterior, composed of the head and thorax, and the other posterior, or the tail. The first segment of the latter, in the female, bears two minute feet, and is not always easily distinguishable from the thorax. The tail is 6-jointed: the terminal joint forked, and more or less furnished with feather-like filaments. The anterior part of the body is divided into four segments. The first, being the largest, composes the head and part of the thorax: it bears the eye, four antennæ, two palpigerous mandibles, two maxillæ, and four legs, each divided into two cylindrical stems. Each of the three following segments is furnished with a pair of feet. The two upper antennæ are long and multiarticulate, assisting in locomotion, having nearly the action of feet. The inferior antennæ are much shorter, filiform, and generally four-jointed. By their rapid movements,

* *Nicothoe*, Aud. and Edw., would belong to this section if furnished with mandibles and maxillæ; but as it is a parasite, and as I think I have observed in it the vestiges of a sucker, I have placed it in the order Pœcilopoda. Its legs, and the mode in which it carries its eggs, agrees with *Cyclops*. *Pontia*, Edwards, appears to be allied to *Cyclops*. The head is distinct from the trunk, and terminated by a rostrum, which is rather acute, and apparently two-jointed. It has two sessile eyes; four antennæ, the superior [long], setaceous, and multiarticulate, the inferior leg-like, and two-branched. The thorax is composed of five segments, and supports five pairs of bifid swimming legs. The abdomen is two-jointed, and terminated by two spatulated appendages. [Type, *P. Savignii*, Edwards. The *Anomalocera minutissima*, Templeton (*Trans. Ent. Soc.*, vol. i. pl. 20), is probably allied to the above.]

they form a current in the water. In the males, both or one of them are constricted and knotted. The upper antennæ were, previous to the researches of Jurine, considered as organs of generation, from the manner in which they are used during coupling. The females are provided, on each side of the tail, with an oval sac, or external ovary, filled with eggs, and attached by a very slender peduncle. A single act of impregnation is sufficient for several successive generations. The female is able to produce as many as ten broods in the course of three months. At their birth, the young have only four feet; and the body is rounded, and destitute of a tail. These individuals were considered by Müller as forming a distinct genus, named *Amymone*. Some time afterwards (fifteen days in February and March), they acquire another pair of legs, in which state they constitute Müller's genus *Nauplius*. After the first moulting, they have the same form and organs as the perfect insect, but the latter are of smaller size. After two more moultings, they are able to propagate their species. The majority of these Crustacea swim back downwards, darting about with great agility, and moving both backwards and forwards with equal ease. In the absence of animal matter, they attack vegetable substances.

Cyclops staphylinus—in its shorter antennæ, which vary in the number of their joints, and in the gradual narrowing of the body, as well as in the curved corneous point with which the under-side of the base of the tail is armed—forms a separate division in the genus.

Cyclops castor, and some other species, having the antennæ and mandibular palpi divided into two branches, form another division.

The subgenus *Calanus* of Leach is described as having no inferior antennæ;—but is this statement original?

The type of the genus is the *Cyclops quadricornis* (*Monoculus quadricornis*, Linn.; and *C. vulgaris*, Leach), which has all the antennæ single, and not divided. The body is ovoid, and the tail six-jointed. The colour varies considerably, some individuals being reddish, others whitish or greenish. The length is one-fifth of an inch. It is very abundant.

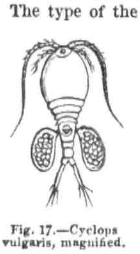
Fig. 17.—Cyclops vulgaris, magnified.

[W. Baird, Esq., has published a very complete memoir upon this genus in the fourth number of the *Magazine of Zoology and Botany*, giving the bibliographical history, anatomy, and economy of the genus, with a monograph of the British species, in great detail. He has given, after Jurine, a calculation, whereby it appears, that at the end of one year, a female which gives birth to forty young at a time, may become the progenitor of 4,442,189,120 young! He has corrected Latreille's observations relative to the genera *Amymome* and *Nauplius*, the species of which the former genus was composed consisting of the young of *C. minutus* in different states, which never assume the form of *Nauplius*, whereas the *Nauplius* is the young of *C. quadricornis*. He considers them to be decidedly carnivorous.]

[Mr. Templeton has described some beautiful species belonging to this genus, in the first volume of the *Transactions of the Entomological Society*, from the Island of Mauritius. One species (*C.* [*Calanus*] *arietis*) is remarkable for the great length of its superior antennæ, which are armed near the tip with two very long recurved setæ. The *Cyclops* (*Anomalocera*) *Pattersonii*, described by the same gentleman in the second volume of the same work, is closely allied to *Cyclops castor*. The males of both species are remarkable for having one of the antennæ greatly swollen beyond the middle, the other being simple.]

[*Cetochilus* of Vauzeme is a singular genus, differing from *Cyclops* in having a pair of eyes. They have two very long, and two very short antennæ; five pairs of short foot-jaws; five pairs of swimming, bifid, and ciliated legs; and a small, narrow, 5-jointed abdomen. Type, *Cetochilus australis* (Vauzeme in *Ann. Sci. Nat.*, 1834), a species found, in inconceivable profusion, beyond 42 of south latitude, in the Pacific and Atlantic Oceans, giving the surface of the sea a red tint, and serving as the food of the whales.—See *Brit. Cyclop. Nat. Hist.*, vol. i. p. 796.]

The second general division of the *Branchiopoda Lophyropa*—that in which the shell is formed of two valves united by a fleshy hinge, and inclosing the body when in inaction—have only six [or eight] legs, none of which are terminated by a branching swimmeret, accompanied by a branchial plate. The antennæ are simple; they have only one eye; the mandibles and anterior maxillæ are provided with a branchial plate; and the eggs are carried beneath the back. These compose our OSTRACODA, or the order *Ostrapoda* of Strauss, and consist of two subgenera, of which the first, *Cythere*, appears to require a more minute examination than has been given to it by Müller, who is our only authority, especially since the elaborate researches of Strauss upon the second subgenus, *Cypris*.

Cythere, Müll., *Cytherina*, Lam., has, according to Müller, eight simple legs terminating in a point, and two antennæ, also simple, setaceous, 5 or 6-jointed, with hairs scattered upon them. The species are found in salt and brackish water, near the shores of the sea, amongst sea-weed and confervæ.* [Mr. Baird, who has carefully examined the structure of these animals, states that they have decidedly eight feet and two antennæ, and that they are only found in sea water.—*Mag. of Zool. and Bot.*, ii. 139.]

Cypris, Müll., has only six† legs, and their two antennæ are terminated by a pencil of [long] hairs. The shell is in the form of an oval body, compressed at the sides, arched and swollen at the back, or part where the hinge is placed; nearly straight, or a little incised and kidney-shaped, on the other side. In front of the hinge, and in the mid-line of the body, the single eye forms a large black and round spot. The antennæ, affixed immedi-

* If these Entomostraca be exclusively marine, it is not surprising that Jurine and other observers, in consequence of their place of residence, should not have spoken of the species of Cythere, confining their attention to the soft water species.

† Four, according to Ramdohr, but eight, according to Jurine; the former regarding the posterior pair as organs of the male sex, and the latter considering the mandibular palpi, and the branchial plate of the superior maxillæ, as legs.

ately beneath, are shorter than the body, setaceous, and 8 or 9-jointed; the terminal joints short, and pencilled with long hairs, form a kind of oar. The mouth is composed of a ridged labium; two large dentate and palpigerous mandibles, the basal joint of the palpi being furnished with a 5-branched branchia; two pairs of maxillæ, the anterior pair also bearing branchial appendages, and the posterior palpigerous. The office of the lower lip is performed by a compressed sternum. The legs are 5-jointed; the two anterior much larger than the others; affixed beneath the antennæ, and directed forwards. The two following legs are directed backwards, and are situated in the middle of the under-side of the body; but the posterior pair never appear out of the shell, but are bent upwards to give support to the ovaries. The body presents no distinct articulation, and is terminated behind in a tail folded beneath the breast, with two setaceous or conical filaments. The eggs are spherical.

Fig. 18.—Cypris vidua, magnified.

The laying of the eggs and the casting of the skins of these Crustacea are not less numerous than those of Cyclops and other Entomostraca, and their mode of life is similar. No recent author has been able to detect their sexual organs. Strauss, indeed, discovered the insertion of a great conical vessel, which he considered to be a testicle; but the individuals which he examined were furnished with ovaries, whence it would seem that the *Cyprides* are hermaphrodites. He, however, observed, in disproof of this opinion, that the males may probably exist at a certain period of the year, and that the vessel he describes may belong to the digestive system.

According to Jurine, the antennæ are real fins or paddles, the animals having the power of extending the threads at will, and according to the rapidity with which they are anxious to swim. We also are of opinion that these filaments may more probably be engaged in respiration, as well as the so-called branchial plates of the jaws. Indeed, the plates of the maxillæ appear to me to be a real, but greatly dilated palpus; and the other two are appendages of the mandibular palpi. Jurine has noticed, that, in swimming, they move these antennæ, and two fore-legs, with rapidity, but slowly whilst crawling on water plants. This pair of legs, together with those of the penultimate pair, at such times support the body. He supposes that those legs, which he regards as the second pair, serve to form a current in the water, and to direct it towards the mouth. The two filaments composing the tail unite, and seem to form but one when pushed out of the shell. It is conjectured that they are used in cleaning the interior of the shell. The female lays her eggs in a mass, fixing them, with a glutinous secretion, to water-plants: this occupation lasts twelve hours. The number of eggs, in the largest species, amounts to twenty-four. Having isolated a packet of eggs, Jurine observed them hatch, and obtained a second generation without the intervention of males. A female which had laid its eggs on the 12th April, had, by the 18th of the following May, changed its skin six times. On the 27th of the same month, it laid a second mass of eggs; and on the 29th, two days afterwards, a third. He therefore concluded that the number of moultings, in the infancy of these animals, has reference to the gradual developement of the individual, which developement can only be effected by a general separation of the envelope, now become too small to lodge the animal, which has a determinate limit to its size.*

[Mr. W. Baird has given a valuable and complete memoir upon this genus in the *Magazine of Zoology and Botany*, vols. i. and ii., describing a considerable number of new British species. He also states that a fossil species occurs in the limestone of Burdiehouse Quarry, near Edinburgh.]

The third general division of the Branchiopodous *Lophyropa* have also only one eye; and the shell is bent in two, but without any dorsal hinge, and is terminated posteriorly in a point. The head is not covered by the shell, but is inclosed in a kind of shield like a beak. They have two very large arm-like branched antennæ, always exserted, and serving as oars. The legs, ten in number, are terminated by a pectinated or digitated fin, and furnished (except the anterior pair) with a branchial plate. The eggs are situated beneath the back. The body is always terminated by a tail, with two setæ at the tip. The front of the body either terminates in a point, or forms an apparently distinct head, occupied entirely by a single large eye.

These are our CLADOCERA, or the *Daphnides* of Strauss, and compose Jurine's second family of *Monoculus*. From the form of a pair of their antennæ, which resemble branches, and serve as oars, and their power of leaping, the common species has obtained the name of the Arborescent Water-flea.

Latona, Strauss, has the antennæ oar-like, divided into three single-jointed branches. *Daphnia setifera*, Müller.

Sida, Strauss, approaches the other known genera in respect to the antennæ, which are, however, divided only into two branches, one being 2-jointed and the other 3-jointed. *Daphnia cristallina*, Müller.

In these and the other genera, there also exists another pair of antennæ, very short, especially in the females, situated at the anterior and lower extremity of the head, composed of a single joint, with one or two setæ at the tip.

Polyphemus, Müller, has the antennæ oar-like, as in Daphnia and Lynceus, divided into two branches, each of which is 5-jointed. Moreover, the head, very distinct and rounded, and affixed upon a short neck, is almost entirely occupied by a single eye of large size. The legs are entirely exposed. A single species only is known (*Monoculus pediculus*, Linn., De Geer; *Polyphemus oculus*, Müller; *Cephaloculus stagnorum*, Lamarck), [about the size of a flea.] The legs are unlike those of the Monoculi of this division, being composed of a thigh, tibia,

* See Müller; Jurine, *Hist. des Monocles*, 2nd division; Ramdohr, Mon. iv. Strauss, *Mém. du Mus. d'Hist. Nat.*, 7. i.; Desmarest, *Considérations* and *Crust. Fossiles*, in which latter work is figured a fossil species named "Cypris fève," found in great abundance near the mountain of Gergovia, in the departement du Puy-de-Dôme, below Vichy-des-Bains and Cussac.

and two-jointed tarsus. From the front of the head arise two very short, single-jointed antennæ. The shell is so transparent that all the viscera may be seen through it. The matrix, when filled with eggs, occupies the major part of its interior; but their number, even in the most numerous broods, does not exceed ten. The eye is the first part of the animal which makes its appearance whilst in the egg. The abdomen is terminated by a long tail suddenly folded back. The animal always swims on its back or sides, giving to its antennæ and legs quick and repeated motions, and executing, with the greatest ease, all kinds of evolutions. It is subject, in its infancy, to the disease alluded to more in detail under Daphnia, named the Ephippium (la Selle); but the Ephippium is always of a determinate shape. Kept in confinement, it soon dies; and its young do not live long after their first moultings. Jurine was not able to detect males amongst the individuals he examined, but the species is rare near Geneva. It is, however, very common in the ditches and lakes of the north of France, [as well as in England], where it may often be seen in considerable troops.

Fig. 19.—Polyphemus stagnorum, magnified.

[*Evadne*, Loven, in *Swed. Trans.*, 1835, differs from Polyphemus in having the head not detached from the body, with the antennæ (or mandibular palpi, according to Loven) bifid. *E. Nordmanni.* Found in the Baltic Sea.]

Daphnia, Muller, has the antennæ as long as the body, divided into two branches, of which the posterior is 4-jointed, the basal joint being very short; and the anterior is 3-jointed. The eye forms a small point, and is not accompanied, except in a few species, by an anterior black dot, mistaken by Müller and Ramdohr for a second eye in Lynceus. Although of such minute size, the anatomy of these animals has been elaborately investigated by Schaffer, Ramdohr, Strauss, and the elder Jurine,—Strauss having especially examined their structure, whilst Jurine closely noticed their habits. The mouth is situated beneath, at the base of the rostrum. We consider as an elongated clypeus the inferior portion of the head, termed labrum by Strauss, and we apply the name of labrum to the part which he terms the posterior lobule of the labrum. Beneath this are two very strong mandibles destitute of palpi, and applied against two horizontal maxillæ, terminated by three strong corneous spines, like recurved hooks. Then succeed ten legs, all of which have the second joint vesiculose; the eight anterior terminated in a fin-like dilatation, with bearded filaments at its edges, arranged like a crown; the two anterior appear more especially organs of prehension. Ramdohr calls them palpi, and Jurine, hands, (as in Cyclops); from the bearded terminal setæ, we do not see why they should not be employed in respiration*, although Strauss has a different opinion. The two hind-feet have a somewhat different form. The abdomen or body is divided into eight segments, perfectly disengaged within the shell, long, slender, and bent down at the tip, which is terminated by two recurved hooks. The sixth segment has a row of tubercles, and the fourth a kind of tail. The eggs remain in a large dorsal sac or matrix, between the shell and the body, for some time after they are discharged from the ovaries. Muller gave the name of Ephippium (la Selle) to a long, dark-coloured spot, which at certain seasons appears after the moulting of the females at the upper part of the valves of the shell, and which Jurine attributes to a disease. According to Strauss, this Ephippium consists of two external plates, riveted on the back by a hinge, and inclosing two oval capsules, each formed of two valves or lateral plates. Each of these capsules incloses a corneous, greenish egg, similar in other respects to the common eggs, but remaining much longer unhatched, and passing the winter in this state, the Ephippium forming a defence at the time of moulting: this Ephippium and its eggs are cast, and the eggs produce young, agreeing precisely with those of the ordinary eggs. The eggs, according to Jurine, hatch in summer in two or three days, but they are capable of remaining for a very long time in a state of desiccation. When the young, which have attained considerable developement in the matrix of the female, are fit to be discharged, the parent suddenly deflexes the tail and they quit the pouch. [Want of space prevents us from giving numerous details relative to the gradual developement of the young.] The males are very different from the females; the head shorter, the rostrum less extended, the valves of the shell narrower and less gibbose, the antennæ much larger. Strauss was unable to detect the sexual organs of this sex. The two valves of the shell terminate in both sexes in a style, toothed on its under-side, curved near its base, and of a length equal to that of the valves. At each moulting, however, this style becomes shorter, so that in adult individuals it forms merely an obtuse point. A single act of impregnation is sufficient for several succeeding (six at least) generations, as proved by Jurine. About eight days after their birth, the young moult for the first time, and repeat the operation every five or six days, according to the state of the weather: not only the body and the valves, but also the branchiæ, and the setæ of the oars, cast off their epidermis. It is not until the third moulting that they begin to produce young, and at first they only lay a single egg, then two or three, the number gradually increasing to as many as fifty-eight in one species (*D. magna*). The following day after laying her eggs, the female moults, and in the shed teguments the shells of the eggs of her last brood are also found. The eggs of each brood are almost exclusively of one sex, it being very rare to find two or three males in a female brood, and vice versâ. In five or six broods in the summer, one at least is of males. These Crustacea cease to breed and to moult at the approach of winter, and are killed by the first frost. The Ephippial eggs which had been laid in the summer hatch in the following spring, and in a short time the ponds or ditches are again peopled with an infinity of *Daphniæ*. Many naturalists have attributed the red colour of some of these waters to the presence of myriads of *D. pulex*; but Strauss has never proved this fact, the species being generally but slightly coloured. In the morning and evening, and even in cloudy days, the Daphniæ generally station themselves on the surface, but in the heat of the day they seek the depths of the water. They swim by taking short springs,

* Strauss indeed considered Cypris and Cythere not to be real Branchiopods, because their feet are not branchial; but we do not see why the hairs of the two anterior and of the antennæ may not, as well as those of the palpi and anterior maxillæ, perform the office of branchiæ.

varying according to the length of their oars and the breadth of their shells. According to Strauss, their food consists exclusively of minute particles of vegetable substances, which they meet with in the water, and often of *confervæ*. They constantly refused the animal matter he gave them. It is by the action of their legs that they produce a current on the water, which brings their food towards the mouth. The hooks at the tip of the tail are used in cleaning the branchiæ. [Mr. Baird has published a detailed account of the anatomy and habits of this genus in the second volume of the *Magazine of Zoology and Botany*.]

The most common species is *D. pulex*, (*Monoculus pulex*, Linn.; *Pulex aquaticus arborescens*, Swammerdam), or the arborescent water-flea. It has the setæ of its oars plumose; its valves are notched on the lower edge, and terminated by a short tail, which is obtuse in the females.

The last subgenus is *Lynceus*, Müller (*Chilodorus*, Leach), distinguished by the oars being shorter than the shell, and of which the lower part does not form a produced point. All the species have in front of the eye a small black spot, having the appearance of a second [frontal] eye.

The second section of the *Branchiopoda*—that of the PHYLLOPA—is distinguished from the former by the number of feet, which is at least twenty,* and in some much more considerable; their joints, or at least the terminal ones, are flattened, lamellar, or foliaceous, and ciliated. The mandibles are destitute of palpi. They have two eyes, (situated in some at the extremity of two moveable peduncles,) and some have also an ocellus; the antennæ, of which there are generally only two, are small, and not fitted for swimming. These Crustacea compose two principal groups.

1. The *Ceratopthalma*, Latr., have at least ten pair of legs, and at the most twenty-two pairs, without any vesicular appendages at their base, and of which the anterior are never much longer than the others, nor ramified. The body is inclosed in a shield, formed like a bivalve shell, or naked, with each of the thoracic divisions bearing a pair of exposed feet. The eyes are sometimes sessile, small, and close together, but more commonly they are situated at the extremity of two moveable peduncles. The eggs are internal or external, and inclosed in a capsule at the base of the tail.

In some species the eyes are sessile, immoveable, and the body inclosed in a bivalve shell; the ovaries are always internal. They form the genus

Limnadia of Ad. Brongniart, which so nearly approach the preceding that Hermann placed the only species known [to him and Latreille] amongst the Daphniæ. The shell is oval, bivalve, and incloses the body, which is long, linear, and inflected in front. Upon the head are placed, 1, two eyes in a transverse direction, and close together; 2, four antennæ, two much longer than the others, each composed of an 8-jointed peduncle, and two 8-jointed setaceous branches, rather silky, and two others intermediate in situation, small, simple, and dilated at the tips; 3, the mouth, situated beneath, consisting of two mandibles, swollen, curved, and truncate at the inferior extremity, and two foliaceous maxillæ. These parts form together a kind of beak, placed beneath. The body, properly so called, is divided into twenty-three segments, each of which (except the last) bears a pair of branchial feet. All these feet are alike, very compressed, bifid, with the outer division simple, ciliated at the outer edge, and the other 4-jointed, and strongly ciliated on the inner edge. The twelve fore pairs of legs are of the same length, and longer than the others, which diminish gradually in length. The eleventh, twelfth, and thirteenth pairs have at the base a slender filament, bent upwards into the cavity between the back and the shell, serving as the support for the eggs. The ovaries are internal, and situated at the sides of the intestinal canal. The eggs, after being laid, occupy the dorsal cavity above noticed, and are there attached by means of small filaments adhering to those of the supports. They are at first round and transparent, but afterwards become darker, and irregular in shape. All the individuals observed by Brongniart were provided with them, so that the males remain unknown (if there are individuals of that sex), and are supposed to appear at a different season from the females. The type, *Limnadia Hermanni* (A. Brongniart, *Daphina gigas*, Hermann), has been found in small pools of water in the forest of Fontainebleau.

[M. Guérin has published a monograph upon this genus in his *Magasin du Zoologie* for 1837, describing three species.]

[*Estheria*, Strauss, (*Cyzycus*, Audouin,) is a genus closely allied to *Limnadia*, found in the Red Sea. Type, *E. Dahalacensis*, Ruppell, in *Trans. Mus. Seckenberg*, 1837.]

In the other species of *Ceratopthalma*, the eyes are placed at the extremities of two long peduncles, formed by the lateral prolongation, like a nose on each side of the head. The body is naked, not inclosed in a shield, and annulated throughout its entire length. The females carry their eggs in an elongated capsule, placed at the base of the tail when present, or at the posterior extremity of the body and thorax in those which have no tail.

Artemia, Leach, has the body terminated by a tail, the eyes borne at the extremity of very short peduncles; the head confluent, with an oval thorax, supporting ten pairs of legs, and terminated by a long and pointed tail.

* These animals represent in this class of Crustacea the Myriapoda in that of the Insecta.

Artemia salina, (*Cancer salinus,* Linn., Montague, in *Trans. Linn. Soc.,* 9. pl. 14,) [the Brine Shrimp] is a very small Crustaceous animal, commonly found in the salt pans at Lymington, in England, when the evaporation of the water is considerably advanced. [Latreille observed that we were in possession of very imperfect characters of this little species. More recently, however, Dr. J. V. Thompson has minutely examined its structure, and has traced the gradual developement of this singular animal, which, when full grown, is about half an inch in length, with a highly polished surface. "Nature having constructed them with members solely adapted for swimming, they seem to be in perpetual quest of prey, gliding with an almost even motion through the water, and moving with equal indifference and facility on the back, belly, and sides; the shape of the animal, the undulating movements of its fins, and the glossy appearance of its coat, renders it an object of a very interesting description."—*Thompson.* M. V. Audouin has published some additional and equally interesting details of it in the *Annales des Sciences Naturelles* for 1837.]

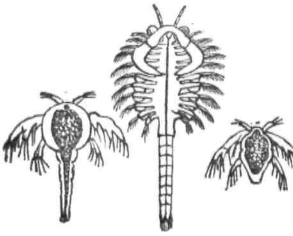
Fig. 20.—Artemia salina, in different stages.

Branchipus, Latr. (*Chirocephalus,* B. Prevost), have the eyes placed at the end of elongated peduncles; the body long, narrow, and compressed, the head distinct from the thorax, with its organs varying in the sexes, with two horn-like projections between the eyes; eleven pairs of legs, and the tail terminated by two ciliated, elongated plates. In both sexes the body is nearly filiform, composed of a head separated from the thorax by a kind of neck, of a thorax channelled beneath, and divided, at least on the upper side, into eleven segments, not including the neck, each of which supports a pair of very compressed branchial legs, generally composed of three lamellar joints, with the edges fringed with hairs, and of a long tail, gradually narrowed to the end, composed of nine segments, terminated by two or more less elongated filaments with ciliated edges. The under side of the second segment of the tail exhibits the male sexual organs, and in the female is furnished with an elongated sac, containing the eggs ready to be laid. The head, (of which the organization of the different parts, especially those of the mouth, requires a more minute investigation than has been given to it by Prevost and Schäffer), presents, 1, two facetted eyes, wide apart, at the end of two flexible peduncles, formed by the lateral prolongation of the head; 2, two frontal antennæ scarcely shorter than the head, slender, filiform, and composed of minute articulations; 3, two produced organs beneath them, either in the form of horns, and composed of a single joint, or finger-shaped and two-jointed; 4, a mouth on the under side of the head, composed of two kinds of toothed mandibles, destitute of palpi, and of some other pieces. We believe that these produced horns are only appendages (but differently constructed in the males) of the frontal antennæ; the two other antennæ may either be obliterated in the females, and may constitute in the males of *C. diaphanus,* Prev., the singular tentacles with teeth, and capable of being rolled up in a coil, which B. Prevost calls the fingers of the hands. The observations of Schäffer upon the hairs of the feet, prove that they are so many aerial canals, and that the surface of the feet to which they are attached is able to absorb a portion of the air which is in contact with them, in the form of bubbles.

Chirocephalus diaphanus, B. Prevost, nearly allied to our *Branchipus paludosus,* if indeed it be distinct, has, on bursting from the egg, the body divided into two nearly equal and nearly globular masses. The anterior exhibits a single simple eye, two short antennæ, two very large oars, ciliated at the end, two short, slender, 5-jointed legs. At the end of the first moulting the two composite eyes appear, the body is gradually elongated, and terminates in a conical, articulated tail, with two filaments at the tip. The subsequent moultings gradually develope the legs, and the oar-like appendages disappear. The *Branchipi* are found, often in great numbers, in small puddles of soft, disturbed water, and often in those formed after heavy rains, especially in autumn and spring. The first frosts destroy them. They generally swim on the back, and their short, lamellar feet, unable to assist in walking, are then kept in an undulatory motion, very agreeable to the sight, and by which a current is produced, which, following the canal of the breast, bears to the mouth the minute particles of the insect's food. When it swims it violently beats the water from right to left with its tail, which gives it sudden jerks. When deprived of a sufficient degree of moisture, it soon ceases to move. The shell of the eggs is thick and strong, which favours their preservation, since it appears that desiccation, unless it be too strong, does not alter the germ, and that the young are subsequently hatched when a sufficient quantity of rain falls. M. Desmarest has often observed the *Branchipus* in puddles of fresh rain-water on the summit of the free-stone (*grès*) of Fontainebleau. The female *Chirocephali* have several distinct layings of eggs, after a single impregnation; each operation lasting several hours, or even an entire day: each brood consists of from one hundred to four hundred eggs, ten or twelve being discharged at once, with sufficient force to embed them in the sand. The two horns, situated beneath the superior antennæ in *Branchipus paludosus,* are composed, in both sexes, of two joints, the last of which is large and curved in the male, and very short and conical in the female. In *Branchipus stagnalis,* the horns are composed of but one joint, those of the male resembling, in their form, direction, and teeth, the jaws of the *Lucanus Cervus,* or Stag Beetle. [There is an interesting memoir on this animal and its transformation, by Dr. Shaw, in the *Linnæan Transactions,* vol. i.]

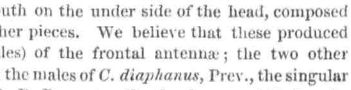
Fig. 21.—Branchipus stagnalis.

Eulimene, Latr., is destitute of a tail, the body, which is nearly linear, terminating immediately behind the thorax and posterior legs: the four antennæ are short, nearly filiform, two being smaller than the others, and nearly resembling palpi, placed at the anterior extremity of the head. The head is transverse, with two eyes placed upon large cylindrical peduncles, eleven pairs of branchial feet, of which the three anterior joints and the terminal one are smaller, and

gradually pointed, and immediately behind them is a terminal, nearly semiglobular joint, replacing a tail, and which is furnished with an elongated filament, probably an oviduct. I have observed near the middle of the fifth and four following pairs of feet a globose body, probably analogous to the vesicles which these organs present in *Apus*. The only species, *E. albida*, Latr., is very small, and of a whitish colour. It is found in the River of Nice.

2. The ASPIDIPHORA, Latr., [or second principal group of the Phyllopodous *Branchiopoda*] have sixty pairs of legs, all of which are furnished on the outside, near the base, with a large oval vesicle, and of which the two anterior, much larger than the rest, and ramose, resemble antennæ. A large shell covers the major part of the upper side of the body, almost entirely disengaged, (shield-like,) posteriorly emarginate, and bearing anteriorly, in a confined space, three simple sessile eyes, of which the two anterior are larger and lunular; and two bivalve capsules containing the eggs, annexed to the eleventh pair of feet. Such are the characters of the genus

Apus, Scop., (forming part of the genus *Binoculus*, Geoffroy, and *Limulus*, Müll.).—The body, including the shell, is oval, broader, and rounded in front, and narrowed behind, forming a tail; but if we remove the shell, it is nearly cylindrical, convex above, concave and divided by a longitudinal canal beneath, terminating in an elongated cone. It is composed of thirty joints, equally diminishing in size towards the posterior extremity, and which, with the exception of the seven or eight terminal ones, bear the feet. The ten anterior segments are membranous, soft, and without spines, presenting on each side a small eminence, or knob, with only a single pair of legs to each. The others are more solid and horny, with a row of small spines on the outer edge: the last is longer than the preceding, nearly square, depressed, angular, and terminated by two filaments, or articulated setæ. In some species, composing the genus *Lepidurus*, Leach, there is a corneous elliptic plate. If the number of legs be one hundred and twenty, the terminal segments after the eleventh and twelfth must severally bear more than a pair of legs, (in which respect these animals approach the *Myriapoda*). The shell, perfectly disengaged beyond its anterior attachment, covers the greater part of the body, and thus defends the anterior segments, which are of a softer consistence than the others; it consists of a large, corneous scale, very slender, nearly diaphanous, exhibiting the superior teguments of the head and thorax united, and forming a large, oval shield, deeply incised at its posterior extremity. Its upper surface is divided by a transverse line, forming two united arcs, into two areas, the anterior of a semilunar form, corresponding with the head, and the other with the thorax. The anterior is furnished with the three eyes, and the posterior is carinated down the middle. The shell is only fixed to the body at its anterior extremity, so that the back of the animal may be distinctly seen throughout its whole length. Immediately beneath the frontal disc are placed the antennæ and mouth. The antennæ are two in number, inserted on each side of the mandibles, very short, filiform, and composed of two equal joints. The mouth consists of a square labrum; two strong, corneous mandibles, destitute of palpi, and toothed at the tip; a tongue, deeply notched; two pairs of foliaceous maxillæ, the superior spined, and ciliated on the inner edge, and the inferior resembling small false legs. They are terminated by a slender, elongated joint, prolonged externally at their base into an ear-shaped appendage, and bearing a kind of palpus. The legs, about one hundred and twenty in number, gradually diminish in size after the second pair; they are all compressed, foliaceous, and composed of three joints, not including the two long filaments at the tip of the two anterior, and the two leaflets terminating the following, which may be regarded as the analogues of a claw, having the two fingers elongated, and converted into antennæ-like filaments; upon the posterior edge of this joint is inserted a large branchial membrane, and the following, or the second, also bears on the same side an oval, vesicular, red sac. The opposite edge of these legs also exhibits four triangular, ciliated leaflets. The eleventh pair of legs is very remarkable; the first joint exhibits, behind the vesicle, two circular valves, applied upon each other, formed of two plates, and inclosing the eggs, which resemble small, red grains. All the individuals hitherto examined have exhibited this structure, and it has, therefore, been supposed that each has the power of fecundating its own eggs, and that there are no males.

These Crustacea inhabit ditches, lakes, and standing waters, generally in innumerable quantities. Raised thence by violent hurricanes into the air, they have been observed to fall like rain. They are generally found in spring and the beginning of summer. Their food principally consists of young Tadpoles. They swim well on the back, and when they burrow into the sand, they elevate their tails in the water. When first hatched they have only one eye, four legs, like oars or arms, with whorls of hairs; the second pair being the largest. The body has no tail, and the shell only covers the front half of the body. The other organs are gradually developed during the succeeding moultings.

The species being few in number, it is not necessary to form (as Leach has done) with those which have a plate between the tails, a distinct genus (*Lepidurus*, Leach), type, *Monoculus apus*, Linn. The ridge of the shield terminates in a small spine posteriorly, which is not the case in *Apus cancriformis* (*Limulus palustris*, Müll.), which latter is also destitute of a plate between the tail. This forms the type of the restricted genus *Apus* of Leach, who has also figured another species, *A. Montagui*.

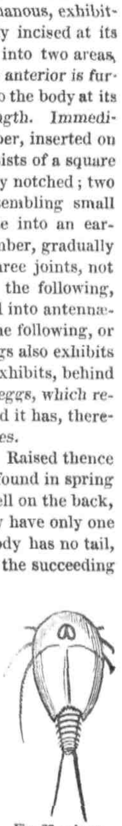
Fig. 22.—Apus Montagui.

[*Prosopistoma*, Latreille, in *Nouv. Mém. du Muséum*, is composed of a minute species from Madagascar, exactly resembling a species of Gyrinus in its external appearance. It is figured in Guérin, *Iconographic Crust.*, pl. 34, 14. *Eurypterus*, Dekay, is composed of a very remarkable fossil animal, allied to *Apus* and other analogous genera, the head not being distinct from the body, which is oval, but attenuated behind, with two large dorsal eyes, and four pairs of legs, the fourth being very large, and like broad oars. *Annals Nat. Hist.*, New York, 1825, p. 375, t. 29.]

THE SECOND ORDER OF ENTOMOSTRACA,—

(*The Seventh and last of the Class* CRUSTACEA),—

PŒCILOPODA,—

Is distinguished from the preceding by the diversity in the form of the feet, of which the anterior, of an indeterminate number, are ambulatory, or fitted for prehension, and the others, lamelliform or pinnated, are branchial, and fitted for swimming. But it is especially in the absence of mandibles and maxillæ of the ordinary form that they are separated from all the other Crustacea; sometimes these organs are replaced by the basal joint of the six anterior legs being armed with numerous minute spines; sometimes the organs of manducation consist either in an external siphon in the form of an inarticulated beak, or in some other instrument fit for suction, but hidden, or very indistinct.

The body is nearly always covered, either entirely or for the most part, by a shell in the shape of a shield, composed of a single piece in the majority, but of two parts in some, and always exhibiting two eyes at least when these organs are distinct. Two of the antennæ (*Chelicerœ,* Latr.) are in many in form of hooks, and perform the functions as such. The number of their legs is twelve in the greater number*, and of ten or twenty-two in nearly all the others. They reside for the most part upon aquatic animals, and most commonly on fishes.

We divide this Order into two families, [XYPHOSURA and SIPHONOSTOMA,] which, in my *Familles Naturelles,* composed two separate orders.

THE FIRST FAMILY OF PŒCILOPODA,—

XYPHOSURA,—

Is distinguished from the following by many characters: they have no siphon; the coxæ of the six pairs of fore-legs are beset with minute teeth, and perform the office of jaws; the number of legs is twenty-two; the ten anterior, with the exception of the two anterior in the males, are terminated by a two-fingered claw, and inserted, as well as the two following, beneath a large semilunar shield; the latter bear the organs of generation, and are in the form of large leaves, as well as the ten following, which are branchial, and annexed to the under side of a second shield, which is terminated by a very powerful, horny, moveable style, like a sword. These animals are wanderers. They compose the genus

Limulus, Fab., of which the species have received the name of [King Crabs], or crabs of the Moluccas. The nearly rounded body, somewhat elongated and narrowed behind, is divided into two parts, and covered by a solid shell of two pieces, one for each division of the body; it is very concave beneath, and exhibits on its upper side two longitudinal impressions, one on each side, and a central dorsal ridge. The fore part of the shell, or that which covers the front of the body, is much larger than the other, and forms a large semilunar shield, having on its upper side two oval eyes, with very numerous facets, in the form of minute grains, and situated one on each side on the outside of the longitudinal ridge; and at the anterior extremity of that of the centre, which extends to the pieces of the shell, are two small, simple eyes, close together. Within the cavity of the anterior shell is a small swollen labrum, ridged in the centre, terminated in a point, and above which are inserted two small antennæ, in the form of small didactyle claws, and elbowed in the middle of their length, at the union of the first and following joint. Immediately beneath are inserted, close together in pairs, in two lines, twelve legs, of which the ten anterior (the two or four anterior in the males only excepted) are terminated by a didactyle claw, and of which the basal joint is advanced interiorly into a lobe armed with numerous minute spines, and performs the functions of the maxillæ. These legs progressively increase in size, and, with the exception of the fifth pair, are composed of six joints, including the moveable finger of the claw; the fifth pair have an additional joint, and also a curved appendage at the base, directed backwards, and composed of two joints; their fifth

Fig. 23.—Limulus polyphemus.

* Fourteen in some species, according to Leach; but the pair which he considers to be the anterior pair, appears to me to be the two inferior antennæ. The Arguli, which, in respect to their locomotive organs, are the most perfect, have only twelve legs.

joint of the leg being terminated on the inner edge by five small, corneous, narrow, elongated, pointed, and moveable plates, and the two fingers are moveable, or articulated at the base. The two pieces situated between these feet, considered by Savigny as a tongue, appear to me to be the two maxillary lobes of these organs, detached and free. The males are distinguished by the form of the claws of the two or four fore-legs, which are swollen, and destitute of a moveable finger. The two terminal legs of the anterior shield are united into a large, membranous leaflet, nearly semicircular, bearing the sexual organs on its posterior face; the joints are indicated by sutures. The second piece of the shell is nearly triangular, and notched at its posterior extremity. Its sides are alternately notched and toothed, and with six spines on each side. In its concave under-side are situated, arranged in pairs, and in two longitudinal series, ten fin feet*, nearly resembling the posterior pair of legs, but united merely at the base, applied upon each other, and bearing on their posterior face the branchiæ, which appear to consist of very numerous fibres.

These Crustacea sometimes attain the length of two feet. They chiefly inhabit tropical seas, and are found near the shore. They appear to be peculiar to the East Indies and coast of America. In the latter part of the world they are called Casserole Fish,—their shells serving, when the legs are removed, to lade water with.

According to M. Leconte, a learned naturalist, they are used for feeding pigs. The natives use the horny style at the extremity of the body in making their arrows, the point being dangerous. Their eggs are eaten in China. In walking, their legs are not seen. Fossil species have been found in strata of moderate age.—Knorr, *Mon. Deluge*, i. pl. 14; Desmarest, *Crust. Fossiles*, xi. 6, 7.

One species, forming Leach's genus *Trachyplæus*, has the four fore-legs, at least in one sex, terminated by a single finger,—*L. heterodactylus*, which I have observed figured in Chinese drawings, and which is probably the Kabutogani or Unkia of the Japanese, by whom it is figured in their primitive Zodiac as the representative of the constellation Cancer. In the others, the two fore-claws, at most, are only monodactyle. All the ambulatory legs are didactyle, at least in the females. This division is composed of numerous species; but which, in consequence of the slight attention which has been bestowed upon the details of them, from the differences of sex and of age, together with their peculiar localities, have not been yet characterized with sufficient nicety. Thus, for example, the young of the common American *Limulus* is whitish, with six strong teeth on the central ridge of the base, and two on each of the lateral ridges; but in others of greater age, and which are a foot and a half long, the colour is much darker, and the teeth have nearly disappeared. We may refer the *Limulus Cyclops*, Fabr., *L. Sowerbii*, Leach, *L. tridentatus*, Leach, and *L. albus*, Bosc, to the former; and to the latter the *Monoculus polyphemus*, Linn., which I had named *L. moluccanus*, considering it peculiar to the Moluccas. In all its states its tail is shorter than the body, and denticulated above, which distinguishes it from other species described by myself and Dr. Leach.—See *Nouv. Dict. d'Hist. Nat.*, second edition, and Desmarest.

[Van der Hoeven has recently published two memoirs on this genus, in his *Magazine of Natural History*, published at Amsterdam.]

THE SECOND FAMILY OF PŒCILOPODA,—

SIPHONOSTOMA,—

Does not exhibit any kind of jaws. A sucker, or siphon—sometimes external, and in the form of an acute inarticulated beak†,—sometimes concealed, or nearly indistinct—occupies the place of the mouth. The number of feet never exceeds fourteen. The shell is very slender, and of a single piece. All these Entomostraca are parasites.

We divide this family into two tribes, [CALIGIDES and LERNÆIFORMES].

The first of these tribes—that of the CALIGIDES, Latr.—is characterized by the presence of a shell, in the form of an oval or semi-lunar shield; by the number of visible legs, which is always twelve (or fourteen, if, with Dr. Leach, we regard the limbs, which I consider as inferior antennæ, as legs); by the form and size of those of the ten posterior‡, which are either slit into many parts, pinnated, or terminated in a swimmeret, and well fitted, in all their stages of existence, for swimming: sometimes they are leaf-like, broad, and membranous. The sides of the thorax never exhibit any wing-like expansions directed backwards, and posteriorly inclosing the body. [The tribe is divisible into two subtribes.]

In the first subtribe, the body—exhibiting, on the upper side, several segments—is elongated, and narrowed posteriorly, terminating in a tail with two filaments, or two other exserted appendages, at the tip. This extremity of the body is not covered by a division of the superior integuments, in the shape of a large rounded scale, deeply notched at its posterior extremity. The shell occupies at least the moiety of the length of the body. This subtribe comprises two genera of Müller [*Argulus* and *Caligus*].

* The two fore-legs may represent the mandibles of the Decapods; the four following feet, their maxillæ, and the six hind-legs, their foot-jaws: so that the fin-feet of the second part of the shell would thence be the representatives of the thoracic legs of the higher Crustacea.

† The composition of this beak is not well understood. It is evident, from Jurine's figure of *Argulus foliaceus*, that it incloses a sucker; but is it the same with the others? and what is the number of the pieces of which it is composed? This we are ignorant of although I presume that it consists of a labrum, mandibles, and a tongue, which forms the sheath of the sucker.

‡ [Latreille says, "*dix* dernières paires;" but he evidently intended only the *five* posterior pairs, or ten posterior legs.]

Argulus, Müll., at first named by me *Ozolus*, but not sufficiently described. The younger Jurine subsequently examined the species which is the type of the genus, with the most scrupulous attention, observing it in all its stages. The shield is oval, notched posteriorly, covering the body, with the exception of the posterior extremity of the abdomen, and supporting, on a triangular frontal space termed the clypeus, two eyes, four very minute antennæ, nearly cylindrical, placed in front—of which the superior, very short and 3-jointed, have, at the base, a strong, toothless, recurved hook, and of which the inferior are 4-jointed, with a small tooth upon the basal joint. The siphon is directed forwards. The legs are twelve in number. The two anterior are terminated by a large limb, circularly dilated at the tip, and striated and toothed at the edge; exhibiting, on the inside, a kind of rosette, formed by the muscles, and seeming to act as a sucking-cup. Those of the second pair are fitted for prehension, with the thighs thick and spinose, and the tarsi composed of three joints, the last of which is terminated by two hooks. The other feet are terminated by a swimmeret formed of two fingers, or elongated pinnulæ, fringed with bearded threads. The third pair of legs has an extra finger, but which is recurved. The last pair of legs is attached to that part of the body which is disengaged behind the shield, or the tail. The abdomen—regarding it as the part of the body extending backwards between the ambulatory feet, the beak, and a tubercle inclosing the heart—is entirely free from the place of its insertion, without distinct articulations, and terminates immediately behind the two last feet in a kind of tail, in the shape of a rounded, deeply-notched plate, without hairs at the tip. It is a kind of swimmeret. The transparency of the integuments permits the heart to be perceived. It is situated behind the base of the siphon, lodged in a solid tubercle, semitransparent, and in the form of a single ventricle.

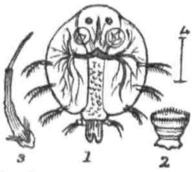

Fig. 24.—Argulus foliaceus. 1, the animal magnified; 2, one of the large anterior sucking-feet; 3, the siphon; 4, natural length.

The eggs are oval, and of a milky white colour: they are attached by gluten to stones or other hard substances, either in one or two rows, to the number of from one to four hundred. The eggs hatch about thirty-five days after they are deposited; and the young ones, on bursting forth, are only three-eighths of a line long. Their general form is similar to that of the adult state, but the locomotive organs exhibit essential differences. Müller described the animal in this state as a distinct species, named *Argulus Charon*. Four long oar-like arms, two placed before and two behind the eye, each terminated by a brush of flexible hairs, which the animal moves simultaneously, and by the help of which it swims easily, with a jerking motion, arise from the anterior extremity of the body. The rudiments of the antennæ are also visible. The two large sucker-like feet are replaced by two strong legs elbowed near the extremity, and terminated by a strong claw, with which the animal affixes itself to fishes. Of the other legs which appear in the adult state, those only of the second and third pairs, or the two ambulatory feet, and the two anterior natatory legs, are the only ones which are developed and free: the following are, as it were, lapped up, and applied against the abdomen. The first moulting, which is effected by means of a rupture of the skin on the under-side of the body, having taken place, the oar-like limbs disappear, and all the natatory legs become disengaged. Three days afterwards, the second moult takes place, which does not produce any important change; but at the third moult, which takes place two days afterwards, we begin to perceive the formation of the suckers of the fore-legs. At the fourth moult, which also takes place at the end of two days, these legs have assumed the sucker shape, preserving, however, the terminal hook. At the end of six days, there is another change of the skin, when the organs of generation become apparent; but there still remains another moult, retarded for six days, before these animals are fitted for reproduction. Thus the period of their metamorphoses extends to twenty-five days. They have then, however, attained only half their size. Other moultings, which take place every six or seven days, are necessary for their arriving at their full growth. Jurine asserts that the females do not become parents without the presence of the males. Those which he kept isolated died of a disease which manifested itself in numerous brown globules, arranged in a semicircle towards the posterior part of the clypeus.

The only species of this genus known [to Latreille] (*Argulus foliaceus*, Jurine; *Monoculus foliaceus*, Linn.; *Argulus delphinus*, and *A. Charon*, Müller; *Monoculus Gyrini*, Cuvier; *Ozolus Gasterostei*, Latr.) attaches itself to the under-side of the body of the young of Frogs, Sticklebacks, &c., and sucks their blood. Its body is flattened, of a greenish-yellow colour, and about two lines and a half long. The younger Herman, who has well described this crustaceous insect in its perfect state, and who cites a manuscript of L. Baldaner, a fisherman of Strasburg, of the date of 1666, where the same animal is figured, says that, in the neighbourhood of that city, it is only found upon the trout, which it destroys, especially in fish-ponds. It is also found upon the perch, pike, and carp. He says it has never been found upon the gills of the fish. This animal turns itself about in the water in a similar manner to the Gyrini. He says its body is divided into five somewhat indistinct segments along the back.

[A most elaborate memoir, containing the description of *Argulus Catostomi*, an American species of this genus, has recently been published by Messrs. Dana and Herrick, in *Silliman's Journal*.]

Caligus, Müll., are destitute of the sucker-like feet. The anterior legs are furnished with hooks: the others are divided into a greater or less number of pinnulæ, or are in the form of membranous leaflets. The shell leaves a considerable part of the body exposed, which is terminated posteriorly, in the majority, by two long filaments, and in others by appendages in the form of fins or styles. The space between these appendages also often exhibits various other minute appendages.

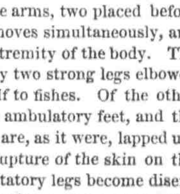

Fig. 25.—*Caligus piscinus*, Linn. *a*, one of the fourth pair of legs; *b*, one of the third pair of legs.

The name of fish-lice, under which these animals are collectively known, indicates that their habits are the same as those of the other Siphonostoma. Many naturalists have considered the tubular

filaments at the extremity of the body as ovaries. I have sometimes found the eggs beneath the posterior branchial legs, but never in these tubes. In other cases, the external ovaries, thus elongated, are only found in those females which lay their eggs in holes or deep burrows; whereas this is not the case with the Caligi. Müller and other zoologists have observed that these Crustacea trim and agitate these appendages. We believe, together with both the Jurines, that they serve for respiration, in the same manner as the anal filaments of Apus.*

The species of the restricted subgenus *Caligus* (including *Risculus*, Leach) have all the legs free, and attached, with the exception of the two last, to the anterior part of the body (*cephalothorax*, Latr.), covered by the shield; and some, at least, of the feet are furnished with numerous filaments. The siphon is not distinct. The abdomen is naked above, and terminated by two long filaments or two styles. *Caligus piscinus*, Latr.; *C. curtus*, Müll.; *Monoculus piscinus*, Linn. The *Oniscus lutosus*, Slabber, ought perhaps to form a distinct subgenus, on account of the fin-like appendages. The *Binocle à queue en plumet* of Geoffroy may be introduced into this subgenus.

[Messrs. Pickering and Dana have published an extremely elaborate description of a species of Caligus (*C. americanus*) found upon the Cod, as many as forty or more individuals occasionally occurring on a single fish; but they are never found within the gill covers. The figures illustrating this memoir have never been surpassed.]

[M. M. Edwards has published a memoir upon this genus in the *Annales des Sciences Naturelles*, especially with reference to the structure of the mouth].

In all the other subgenera of Caligus, the upper side of the abdomen is imbricated, or this part of the body is as though it were inclosed in a kind of case, formed by the terminal feet, which resemble membranes, and are turned upwards.

Pterygopoda, Latr. (*Nogaus?* Leach), has the posterior extremity of the body terminated by two fin-like appendages. It has digitated feet on the under-side of the post-abdomen, or second division of the body, not covered by the shield, and a distinct beak. Founded upon a single species, found on the shark.

Pandarus, Leach, has two filaments at the posterior extremity of the body. The legs, of the first and fifth pairs, are unguiculated, and the others digitated. The siphon is not distinct. *Pandarus bicolor*, Leach; *P. Boscii*, Leach, &c. [Two other species of this genus have been described and figured by Dr. Johnston, in the *Magazine of Natural History*, vol. viii.]

Dinemoura, Latr., has two long filaments at the anus, but in which the siphon is distinct. The two fore-legs are unguiculated; the two following are terminated by two long fingers; the others are in the form of membranous leaflets. *C. productus*, Müller; *M. salmoneus*, Fabr.

Anthosoma, Leach, approaches the preceding, as regards the existence of the siphon and the two anal filaments; but it recedes from it, as well as the two preceding, in its antennæ, of which two are directed forwards, in the shape of small monodactyle claws, and in the six hind-legs, which are membranous, folded upwards, at the sides, upon the post-abdomen, which they envelope. The first and third pairs of legs are unguiculated; and the second terminated by two short, obtuse fingers. *Anthosoma Smithii*, Leach.

[*Nemesis*, Risso, is a curious genus, of a narrow form, with the anal filaments many times longer than the entire body.—See *Pol. Roux*, *Crust. Mediter.*, pl. 20.]

In the second subtribe of the Caligides, the body is oval, without exserted anal appendages, in the form of filaments or fin-like scales. A portion of the superior integuments composes in front of the body a shield, which does not cover the anterior half, narrower than it, rounded, and notched anteriorly, dilated and bilobed at the other end, succeeded by three other pieces, or rounded scales, posteriorly notched, the second of which is the smallest, being in the shape of a reversed heart; the last is the largest. The four posterior legs are in the form of plates, united in pairs; those of the first and third pairs are unguiculated; the second are bifid at the tip. The siphon is apparent. The eggs are covered by two large, oval, contiguous, coriaceous pieces, placed beneath the abdomen, and surpassing it in length.

Such are the characters of the genus

Cecrops, Leach, of which a single species is only known, which has been found fixed to the branchiæ of the tunny and turbot. *C. Latreillei*, Leach.

The second of the tribes of the *Siphonostoma*—that of the LERNÆIFORMES, Lat.,—is composed of Entomostraca still nearer allied than the preceding to the Lernææ. The number of the legs does not clearly exceed ten, (but there is perhaps another pair still more minute), and these organs are, for the most part, very short, and unfitted for swimming. Sometimes the body is nearly vermiform, cylindric, with the anterior segment simply a little wider, and furnished with two didactyle advanced claws, and sometimes, in consequence of two lateral expansions in the shape of lobes or wings, directed behind the thorax, and of the two ovaries, which are posterior, it forms a small quadrilobed mass. This tribe comprises two genera.

* In the third volume of the *Annal. Gener. des Sci. Physiq.*, p. 343, printed at Brussels, there is an extract from the observations of Dr. Surriray, upon the fœtus of a species of Caligus (*C. elongatus?*) which is very common upon the operculum of *Esox Belone*. This naturalist states, that, having crushed the anal filaments of the animal, he observed many membranous and transparent eggs discharged, each inclosing a living fœtus, very different from its parent, and of which he gives a description. From these observations, these filaments would seem to be exterior oviducts; but is there not some error in this statement? I have studied, with great care, these organs in many specimens—preserved, it is true, in spirits of wine—but I have never yet discovered any body inclosed in them.

Dichelestium, of the younger Hermann, has the body narrow, elongated, slightly dilated in front, and composed of seven segments, the anterior being larger, rhomboidal, and composed of the head and part of the thorax united. It supports, 1, four short antennæ, the lateral ones being filiform, 7-jointed, and the intermediate pair advanced like short arms, 4-jointed, with the last in the form of a didactyle claw; 2, a siphon on its under-side, membranous and tubular; 3, three kinds of mis-shapen palpi (two many-cleft legs?) on each side, situated on an elevation; and, 4, four feet fitted for prehension, of which the two anterior are terminated by several unequal-sized, toothed hooks, and of which the second pair are terminated by a strong hook. Each of the second and third segments supports a pair of legs formed of a joint terminated by two kinds of fingers, toothed at the tip. To the fourth segment is attached a fifth pair of legs (the last), being in the form of simple, oval, and immovable vesicles, which Hermann regarded as ovaries rather than legs. The hind segment is flattened, and terminated by two minute vesicles. The eyes are not distinct.

Fig. 26.—Dichelestion sturionis.

D. sturionis, Hermann, is about seven lines long. The legs are only seen when the animal is reversed. It [is found upon the Sturgeon], into the skin of which it insinuates itself deeply. Hermann found as many as twelve on one fish. Two or three of this number, males probably, were one-third shorter than the others. They twist themselves about with great rapidity. They affix themselves very firmly by their frontal claws.

Nicothoe, Aud. and M. Edwards, terminates the class of the Crustacea, and is distinguished by its anomalous form. With the naked eye, it appears to consist only of two large lobes united together, somewhat like a horse-shoe, inclosing two others; but, with the microscope, it appears that the two large lobes are two large lateral expansions of the thorax, having the appearance of wings, nearly oval, and directed backwards, and that the two others are external ovaries, like those of the female Cyclops, attached by a small peduncle to the base of the abdomen. The body consists of, 1, a distinct head, supporting two eyes widely apart; two short, lateral, setaceous, 11-jointed antennæ; the mouth formed of a circular opening, performing the office of a cup, accompanied, on each side, by maxilla-shaped appendages (fore-legs); 2, a thorax, composed of four segments, having, on the under-side, five pairs of legs, the two anterior terminated by a strong hook, and the eight others composed of a large joint, terminated by two nearly cylindrical, sub-equal branches, each composed of three joints; and, 3, an abdomen, pointed behind, composed of five joints, the first largest, and supporting the pair of large, oviparous sacs, the last terminated by two long bristles. The lateral expansions appear to be only the excessive developement of the fourth and last segments of the thorax.

N. astaci (Aud. and M. Edwards, *Ann. Sci. Nat.* 1826) is half a line long, and about three lines wide, including the thoracic prolongations. It is of a rosy hue, with the lateral expansions yellowish. It attaches itself firmly to the branchiæ of the lobster, burying itself deeply in the filaments of these organs. They occur in small quantities, and only upon certain individuals. All the specimens hitherto observed were furnished with these ovaries. It is probable, however, that, previous to becoming fixed, they are able to swim; and that, at that period, their thoracic lobes had not acquired their ordinary developement.

[The animals composing the Siphonostoma are, comparatively speaking, the most imperfectly organized of all the Crustacea; a peculiarity probably resulting, at least to a certain degree, from their parasitic habits. Latreille, in his introductory observations, had noticed the relation of some of these animals with the Lernææ, but doubted the existence of any actual affinity between them. Two Prussian naturalists, however, Dr. Von Nordmann, and my friend Burmeister, have more recently published some elaborate memoirs upon these animals, which completely prove their relation: this is especially the case with such genera as *Achtheres*, *Ergasilus*, &c., which have not only articulated bodies and jointed members, but their young are active animals, very closely resembling the young of many of the more imperfect Branchiopoda. Dr. Burmeister, whose memoirs are published in the 17th volume of the *Nova Acta Cæs. Nat. Curios.*, accordingly unites these together into one group, which he calls *Schmarotzerkrebse* (*Siphonostoma*, Latr.) divided into five families: 1, PENELLINA, comprising the genera *Lernæa*, *Lernæocera*, *Peniculus*, and *Penella*; 2, LERNÆODA, genera, *Anchorella*, *Tracheliastes*, *Brachiella*, *Lernæopoda*, *Achtheres*, *Basanistes*, *Condracanthus*, and *Lernanthropus*; 3, ERGASILINA, genera, *Nicothoe*, *Ergasilus*, *Bomolochus*, *Lamproglene*, *Anthosoma*, *Dechelestium*, *Nemesis*; 4, CALIGINA, genera, *Cecrops*, *Chalimus*, *Caligus*, *Pandarus*, and *Dinematura*; 5, ARGULINA, consisting of the single genus *Argulus*.*]

* [I regret that want of space prevents me from giving an account of the very elaborate details relative to these singular animals, which are thus rendered doubly interesting from being upon the confines of two of the great animal subkingdoms. M. Kollar has also published the descriptions of some new species in the last number of the Vienna *Transactions*.]

THE TRILOBITES.

Near the Limuli and other Entomostraca provided with a great number of legs, should be arranged, in the opinion of M. Alexandre Brongniart, and other naturalists*, those singular fossil animals, at first confounded together under the common denomination of *Entomolithus paradoxus*, but now called Trilobites, of which that author has published an excellent monograph, illustrated by good lithographic figures. According to this hypothesis, we must admit, as a positive fact, or at least as most probable, the existence of locomotive organs, although, notwithstanding all research, no vestige of them has yet been detected.† Supposing, on the other hand, these fossil animals to be destitute of such organs, I have supposed that they are more naturally allied to the Oscabrions, or rather that they formed the primitive type (*la souche primitive*) of the articulated animals, being allied, on the one hand, to the last-mentioned Mollusca, and on the other, to the above-mentioned Crustacea, as well as to Glomeris ‡, to which certain Trilobites, such as Calymene, make an approach as well as to the Oscabrions, because, like them, they are capable of contracting themselves into a ball. Since the publication of the work of M. Brongniart, several naturalists have not agreed with his opinion, but, on the other hand, have either partially or entirely adopted mine: others still hesitate. Be this as it may, these animals appear to have been annihilated during the ancient revolutions of our planet.

With the exception of the heteromorphous genus, *Agnostus*, the Trilobites have, like the Limuli, a large anterior segment, in the form of a shield, nearly semicircular, or lunulated, and succeeded by about twelve to twenty-two segments §, all, except the last, being transverse, and divided by two longitudinal furrows into three rows of lobes, whence the origin of the name of Trilobites.|| They are named by some authors *Entomostracites*.

The genus *Agnostus*, Brong., is the only one which has the body either semicircular or kidney-shaped. In all the other genera it is oval or elliptic.

Calymene, Brong., differs from the others by the power it possessed of contracting the body into a ball, in the same manner as *Sphæroma, Armadillo, Glomeris*, that is, by causing the two extremities to approximate beneath the breast. The shield, as broad or broader than long, exhibits, as in *Asaphus* and *Ogygia*, two eye-like eminences. The segments do not extend laterally beyond the body, and are united together as far as the extremity; the body is terminated posteriorly in a kind of triangular, elongated tail.

* M. E. Deslongchamps, Professor at the University of Caen, the Count de Rasoumouski, M. Dalman, and others, have recently published various observations upon these fossils. M. V. Audouin, having adopted the opinion of Brongniart, has opposed, in a memoir upon this subject, that which I had given, whereby I had approximated them to the Oscabrions. The most essential difficulty was to prove the existence of legs, and this he has failed in doing. As to the application *of his theory of the thorax* of insects to the Trilobites, it appears to me the more doubtful, because, in my mode of looking at the subject, the anterior segments of the abdomen of insects alone represent the thorax of the decapod Crustacea.

† Mr. [Parkinson] in his Outlines of Oryctology, nevertheless believes *that he has detected these organs, and that they are unguiculated*. See also the *Entomostracite Granuleux of Brongniart, Trilob.*, iii. 6. [See also the 15th vol. of the *Annales des Sciences Naturelles*.]

‡ (1st edit. of this work, tom. iii. p. 150, 1.) No known Branchiopod contracts itself into a ball. This character is confined, amongst the Crustacea, to Typhis, Sphæroma, *Tylos, and Armadillo; and amongst* the apterous insects, only to Glomeris, which is at the head of its class, and which leaves a great space between it and the terminal Crustacea. Calymene evidently approaches, in respect to the contractility, the last-mentioned insects, Typhis and Sphæroma; but it does not appear that the hind part of its body is provided with lateral natatory appendages, a negative character, which separates them from Sphæroma, but which approximates them to Armadillo, and especially to Tylos. The examination of a specimen well preserved has convinced me that they had, like the Limuli, dorsal eyes, with two elevations, of which the cornea was granulose or facetted. In respect to their want of superior antennæ, they have a further affinity with Limulus.

§ It appears that in various Trilobites, and particularly in Asaphus, the body is composed, in addition to the shield, of twelve segments detached from each other at the sides, and of another composing the post-abdomen or tail, of a triangular or semilunar form, exhibiting only superficial divisions, which do not cut the sides. In Paradoxides, on the contrary, its lateral lobes are terminated by acute prolongations, quite distinct, and of which twenty-two are easily counted. A *species of Trilobite mentioned by Count Rasoumouski* (*Ann. Sci. Nat.*, June, 1826, pl. xxviii. fig. 11), which he considers should form a new genus, is very remarkable in this respect. Its lateral lobes form very long points. The feet of the pupæ of the gnats are in the form of long flattened plates, without articulations, terminated by filaments, *and folded back on the sides; they are in a rudimental state*, and may be analogous to the lateral divisions of this species of Trilobite which is allied to the Paradoxides.

|| The Squillæ, various Amphipod and Isopod Crustacea, have also many of their segments divided into three portions by two impressed longitudinal lines, but these lines are nearer to the margin, and do not form deep channels.

In *Asaphus*, Brong., the ocular tubercles appear to exhibit a covering, or are granular; the tail-piece terminating the body, is less elongated than in Calymene, and nearly semicircular, or in the shape of a short triangle.*

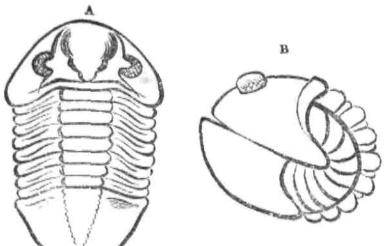

Fig. 27.—A, Asaphus expansus. B, The same rolled up.

In *Ogygia*, Brong., the shield is longer than broad, with the posterior angles produced into a spine. The ocular prominences exhibit neither covering nor granulations. The body is elliptic.

These eminences, having the appearance of eyes, either do not exist, or are not distinctly to be seen, in the genus *Paradoxides*, Brong. The segments, or at least the majority of them, extend laterally beyond the body, and are disengaged at their extremity on the sides.

Such are the characters of the five genera established by M. Alex. Brongniart, and which may be arranged into three groups: 1, the Reniformes (genus *Agnostus*); 2, the Contractiles (g. *Calymene*); 3, the Extensi (g. *Asaphus*, *Ogygia*, and *Paradoxides*). We refer for a knowledge of the species and their respective strata, to the work of the above-mentioned celebrated naturalist, who has associated with him, in respect to the fossil Crustacea, M. Desmarest, so often cited by us in our accounts of fossil and recent Crustacea. Other savans have proposed other genera amongst the Trilobites; but being confined to the most general considerations, I can only cite those which appear in the best work yet published on these singular fossils.

THE SECOND CLASS OF ARTICULATED ANIMALS FURNISHED WITH ARTICULATED LEGS,—

ARACHNIDA,—

Is, like the Crustacea, [composed of species] destitute of wings, and which are in a manner not liable to change their form, not undergoing metamorphosis, but simple sheddings of the outer covering of the body. Their sexual organs are placed at a distance from the posterior extremity of the body, being (except in some males) at the base of the venter. But they differ from these animals as well as from the true insects in many respects. As in the latter, the surface of their bodies exhibits orifices or transverse slits, named stigmata (but which it would be better to name Pneumostomes,—mouth for the air,—or spiracles, that is, respiratory orifices), serving for the entry of the air, but being few in number, (eight at most, generally only two), and situated only on the under side of the abdomen. Respiration is effected either by means of aerial branchiæ, serving as lungs and inclosed in bags, to which these spiracles form the entry, or by means of radiating tracheæ. The organs of sight consist only of minute simple ocelli, grouped in different positions when there is a number of them. The head, generally united to the thorax, merely exhibits at the place of the antennæ two articulated pieces, like small didactyle or monodactyle claws, which have been injudiciously compared to the mandibles of insects, and so named; but they move in a direction opposed to the motion of mandibles, or up and down, assisting, nevertheless, in eating, and replaced, in those Arachnida which have the mouth formed into a siphon or sucker, by two pointed plates, used as lancets.† A sort of lower lip (*labium*, Fab.), or rather tongue, (*languette*), formed

* *In Asaphus, Brongniart, described and figured by M. E. Deslongchamps*, the posterior angles of the shield, instead of being directed backwards, as in the other species, are recurved.

† Cheliceræ, or antennal claws, for such they are evidently, as proved by a comparison of these organs with the intermediate an*tennæ of various Crustacea, especially those of the order Pœcilopoda.* Hence it is not quite correct to say that the Arachnida are destitute of antennæ, a negative character, by which they have been defined by preceding authors.

by a pectoral elongation; two maxillæ, formed of the basal joint of two small feet or palpi *, or of an appendage or lobe of the same joint; a piece concealed beneath the mandibles, and called the sternal tongue by Savigny in *Phalangium copticum*, and which is composed of a beak-like prominence, produced by the union of a very small epistome or clypeus, terminated by a very small triangular upper lip, and of a longitudinal lower rib (*carène*) generally very hairy. These, together with the pieces called the mandibles, generally constitute, with certain modifications, the mouth of the majority of the Arachnida. The pharynx † is placed in front of a sternal prominence, which has been considered as a lip, but which, from its situation immediately in front of the pharynx, and from being destitute of palpi, is rather a tongue. The legs, like those of the Insecta, are generally terminated by two small hooks (*ungues*) and sometimes by an additional one, and all are annexed to the thorax (or rather cephalothorax), which, except in a few species, is only composed of a single piece, and very often intimately united to the abdomen, which is soft or but weakly defended in the majority.

With respect to their nervous system, the arachnida remarkably differ from the Crustacea and Insecta, for, if we except the Scorpions, which, in consequence of their articulated tails, have some extra ganglions, the number of these knots does not exceed three, and even in those animals there are only seven.

The majority of the Arachnida feed upon insects, which they seize alive, or upon which they fix themselves, and from which they suck their juices. Others live as parasites upon the bodies of vertebrated animals. There are, however, some which are found only in flour, cheese, and upon various vegetables. Those which subsist upon other animals often increase in a very great degree. In some species two of the legs are not developed before a change of skin, and in general it is not until after the fourth or fifth moulting that these animals become fitted for reproduction.‡

Those species which have pulmonary sacs §, a heart with very distinct vessels, and six or eight eyes, compose the first Order, *Arachnida pulmonaria*.

The others respire by tracheæ, and do not possess organs of circulation; or, if they be present, the circulation is not complete. The tracheæ are divided near their origin into different ramifications, and do not form, as in the Insects, two canals, running parallel with the entire length of the body, and receiving the air in its different parts by numerous breathing pores. Here we can only distinctly perceive two ‖ at most, situated near the base of the abdomen. The number of the simple eyes is four at the most. These form our second and last Order, *Arachnida trachearia*.

* These organs do not differ from true legs, except in their tarsi, composed of a single joint, and generally terminated by a small hook, similar to the ordinary legs of the Crustacea. These maxillæ and palpi appear to correspond with the palpigerous mandibles of the decapod Crabs, and to the two fore-legs of Limulus; the four following legs of *Phalangium* have a basal *maxillary* appendage, *analogous* to the four maxillæ of the preceding animals, described by me in my monograph of the French Phalangia, years before Savigny's Memoirs were published. Hence it is easy to refer all these articulated animals to one general type, and hence the Arachnida are not a kind of Crustaceous animals, destitute of a head, as Savigny says.

† M. Strauss and myself have only observed one orifice, although Savigny admits (but, as it seems to me, incorrectly) two.

‡ We have also seen that the Argulus does not attain this power until after the sixth moult. The same fact is also applicable to Lepidopterous insects, and probably to others which change their skins several times — thus, Caterpillars moult four times before assuming the chrysalis state, which is effected by a fifth moult, and the insect does not become an imago until after another, which makes six moultings.

§ *Sacs inclosing aerial branchiæ, or performing the office of lungs,* and which I distinguish from the latter organs by the name of pneumobranchiæ.

‖ The Pycnogonides are destitute of spiracles, and thus appear to approach the terminal Crustacea, such as Dichelestium and other Entomostraca suctoria. Savigny considers them most allied to the Læmodipodous Crustacea, *from which, however, they widely differ in* the structure of the mouth, eyes, and legs. We believe them to belong rather to the class Arachnida, near to Phalangium, considering they may respire by the surface of their skin.

[It is to be observed, that these two orders are regarded by various celebrated naturalists as too widely distinguished from each other to remain in the same class. This idea was first entertained by Dr. Leach, (*Zoological Miscellany*, vol. iii. 1817), who restricted the class to the families Scorpionidæ, Tarantulidæ, Phalangidæ, Solpugidæ, and Araneidæ, all of which were assumed to breathe by means of pulmonary sacs, whilst the Trachearia of Latr. (excepting the Pycnogonidæ and Phalangidæ), were formed into a separate class, which he proposed to name Acari. Even Latreille himself, in his *Cours d'Entomologie*, thought it necessary to separate the Pycnogonides into a distinct order of the class Arachnida, which he named Aporobranchia. Messrs. Kirby and Spence (*Introd. to Entomology*, vol. iii. p. 21) were also of opinion that the Pulmonary and Trachean Arachnida should not be included in the same class; but Mr. MacLeay (*Horæ Entomologicæ*, p. 382) maintained that the diversity of the organs of respiration and circulation is not to be depended upon in the classical arrangement of the Annulosa; and more recently Dugès, in his memoir upon the Acari, adopted a similar view, considering that external form and general coincidence of characters, such as the presence of eight feet for walking, the absence of organs used as antennæ and reticulated eyes, and the constant union of the head and thorax, are of more importance than the variations in the organs of respiration and circulation. This, which I consider as the most philosophical view of the subject, (confirming as it does my observation on the distribution of the Crustacea proposed by M. Duverney, *antè*, p. 410, note,) has been still more recently confirmed by Dugès, who has read a memoir before the French Institution, in which the genera Dysdera and Segestria, belonging to the Spiders, are stated to possess four spiracles, two of which are connected with pulmonary, and two with trachean organs (see *Guérin*, *Bull. Zool.*, No. 2). This author has illustrated this structure in the Crochard edition of the *Règne Animal*, livr. 10, Arachnides, pl. 10, f. 4. With the view of adapting the arrangement of Leach to that of Latreille, I have proposed the following distribution of the class (*Ent. Text Book*, p. 131).

Section I. PULMONARIA, Latr.

Order 1. *Dimerosomata*, Leach, *Araneides*, Latreille.

Order 2. *Polymerosomata*, Leach, *Pedipalpi*, Latreille, (*Scorpionidæ* and *Phrynidæ*).

Section II. TRACHEARIA, Latr.

Order 3. *Adelarthrosomata*, Westw., composed of the families *Solpugidæ*, *Cheliferidæ*, and *Phalangiidæ*.

Order 4. *Monomerosomata*, Leach, restricted to the *Acari*.

Section III. APOROBRANCHIA, Latr.

Order 5. *Podosomata*, Leach, consisting of the single family *Pycnogonidæ*.

The Baron Walckenaer, in his valuable *Histoire Naturelle des Insectes Aptères*, (Paris, 1837, 8vo, tom. i.), has divided the Arachnida of Latreille, which he names *Acères*, after Lamarck, (not adopting the views of Latreille that the chelicerae are modified antennæ), into six orders:— 1. The ARANEIDES (*Theraphoses* and *Araignées*); 2. PHRYNEIDES (*Phrynus*, *Thelyphonus*); 3. SCORPIONIDES (*Scorpio*, *Chelifer*, and *Obisium*); 4. SOLPUGIDES (*Galeodes*); 5. PHALANGIDES (*Phalangium*, *Siro*, *Macrocheles*, *Trogulus*, and "*Mites*"); 6. ACARIDES (*Trombidium*, *Hydrachna*, *Gamasus*, *Ixodes*, *Acarus*, *Eylais*, *Bdella*, and *Oribata*). Thus we find that the respiratory organs

have not been adopted as the ground-work of this arrangement, Chelifer and Scorpio being united together, whilst in the fifth order we find the " Mites " (but no definition is given to enable us to judge what group is thereby intended) separated from the remainder of the Acarides, which form the sixth order.

In this valuable work the author proposes to treat of all the Apterous insects, exclusive of the Crustacea; but the first volume only is yet published. Distinguished as its author has long been for his writings upon the Arachnida *, the present work, forming a portion of the *Suites à Buffon*, is very valuable, as containing a mass of materials never before published, with the substance of the various works which the author has already given to the world. Much interesting detail relative to the habits of these animals is here collected, and a great number of species as well as genera of Spiders, are described in this volume.]

THE FIRST ORDER OF ARACHNIDA,—

PULMONARIA, (UNOGATA, Fabricius),—

Possesses, as above stated, a system of circulation well defined, and pulmonary sacs, always placed beneath the belly, and externally indicated by transverse orifices (*stigmata*), sometimes eight in number, four on each side, but sometimes four or only two in number. The number of simple eyes is six or eight †, whilst in the following order there are not more than four, often two, sometimes very indistinct or even wanting.

The heart is a great vessel, extending the whole length of the back, and emits branches on each side, and in front.‡ The legs are constantly eight in number. The head is also soldered to the thorax, and exhibits at its anterior and upper extremity two claws, (mandibles of authors, but named chelicera or antennal claws by Latreille,) terminated by two fingers, one of which is moveable, or by a single one, which forms a moveable hook.§ The mouth is composed of a labrum, (see the general observations on the class); two palpi, sometimes having the appearance of arms or claw-legs; two or four maxillæ, composed, when there are only two, of the basal joint of the first pair of legs; and of a tongue of one or two parts.‖ By taking, as the ground of classification, the progressive diminution of the pulmonary sacs and spiracles, the Scorpions, in which there are eight, (whilst there are only four or two in other Arachnida,) ought to form the first genus in the class; and hence our family Pedipalpi, to which it belongs, ought to precede that of the spinning species (*Araneides*), which arrangement I adopted in my *Familles Naturelles*, and Dufour also is of a similar opinion. But these last Arachnida are in some respects isolated, in consequence of their male organs of generation, the hook of their frontal claws, their abdomen pedunculated, the spinnerets, and their habits. The Scorpions, moreover, seem to form a natural passage between the pulmonary Arachnida and the family of the Pseudo-scorpions, the first of the following order. We therefore commence with the Spinning Arachnida.

* See his *Faune Parisienne*, Insectes, f. 2; *Tableau des Araneides*, 1805, 8vo; the *Faune Française*, and *Mémoire sur une Nouvelle Classification des Araneides*, in the Annals of the Entomological Society of France.

† *Tessarops*, Rafinesque, is described as having only four eyes, but I suppose the lateral ones were overlooked. See *Eresus*.

‡ According to M. Marcel de Serres, the blood in the Spiders and Scorpions is carried first to the respiratory organs, and thence, by peculiar vessels, to the different parts of the body. But from analogy with the Crustacea, the circulation is probably effected in the reverse manner. (See Treviranus on the anatomy of these animals.)

§ These organs consist of a swollen basal joint, of which one of the superior angles (when the claw is didactyle), is produced, forming the fixed thumb, and of a second joint, which constitutes the moveable piece, either as an opposed finger or as a simple hook.

‖ That of the Scorpions appears to consist of four pieces in the shape of an elongated, pointed triangle, produced in front; but the two lateral ones are evidently formed of the first joint of the two fore-legs, and may be considered as two maxillæ analogous to the two first maxillæ. In Mygale, Scorpio, &c., the palpi are 6-jointed, the first joint of which, in the other Spiders, is dilated to form the maxillary lobe. This lobe, even, in some species, is articulated at its base. If we pass over this joint, the palpi are only 5-jointed, as ordinarily described. In the Scorpions the terminal moveable finger of the claws forms, as in the claws of the Crabs, a sixth joint.

THE FIRST FAMILY OF THE PULMONARY ARACHNIDA,—

THE FILEUSES OF ARANEIDES,—

Consists of the genus of Spiders, ARANEA, Linn., in which the palpi resemble small feet without a claw at the tip, terminated at most in the females by a small hook, and of which the terminal joint incloses or supports, in the males, various appendages, more or less complicated, employed in generation.* The frontal claws (mandibles of authors) are terminated by a moveable hook, which folds downwards, having on its under side, near its pointed extremity, a small slit for the emission of venomous fluid secreted in a gland of the preceding joint. The maxillæ are never more than two in number; the tongue is of a single piece, always external, and situated between the maxillæ, and more or less square, triangular, or semicircular. The thorax † has generally a V-like impression, indicating the region of the head, but consists of a single piece, to which is posteriorly attached, by means of a short peduncle, a moveable and generally soft abdomen. This part of the body is furnished in all the species beneath the anus with four or six nipples, fleshy at the tips, cylindrical or conical, articulated, closely approximating together, and pierced at the extremity with an infinity of minute orifices ‡ for the discharge of silken threads of an extreme tenuity, emitted from internal reservoirs. The legs, identical in form, but different in length, are composed of seven joints, of which the first two form the haunch, the next the femur, the fourth § and the fifth the tibiæ, and the two others the tarsus. The last is ordinarily terminated by two ungues, generally toothed beneath, and by a third smaller unguis, not toothed. The intestinal canal is straight; the first stomach is composed of several sacs, and about the middle of the abdomen is a second stomach-like dilatation.

The nervous system is composed of a double chord, occupying the mid-line of the body, and of ganglions, which distribute nerves to the various organs. According to Treviranus, the number of ganglions is only two. The upper surface of the abdomen exhibits, especially in the smooth, naked species, various impressed spots, differing in number and situation, which, according to Dufour, are produced by the attachment of the filiform muscles which traverse the liver. The pulmonary orifices, two or four in number, are indicated externally by as many yellowish or whitish spots near the base of the belly, immediately after the segment, which, by means of a fleshy filament, unites the abdomen with the thorax. Each pulmonary mass is formed by the superposition of a great number of white, triangular, extremely slender plates, which become confluent around the spiracles, of which the number is the same as that of the pulmonary sacs. The female Araneides have two ovaries, quite distinct, lodged in a kind of capsule formed by the liver. With respect to the simple eyes, Dufour observes, that they shine in the dark like those of the Cat, and that in effect the Araneides can see both by day and night. The abdomen of Spiders is subject to so great an alteration after death that its colours and even its form are not recognizable. Dufour has, however, been enabled, by means of very rapid desiccation (of which he has given the process), to remedy this evil in a great degree.

According to Réaumur, the silk undergoes a first elaboration in two small reservoirs, like drops of glass, placed obliquely, one on each side, at the base of six other reservoirs, like intestines, situated at the side of each other, and folded up six or seven times, and proceeding to the nipples by a very slender filament. It is in these latter vessels that the silk acquires greater strength, and other properties which it possesses. On leaving the nipples the silken threads are glutinous; they require a certain degree of desiccation or evaporation of humidity to fit them for use. But it appears that in favourable weather a moment is sufficient, the animals making use of their threads as soon as they are discharged. The white, silky masses seen floating in the air in spring and autumn, called in France *fils de la vierge*, are certainly produced, as we have proved, by tracing them from their point of departure, from various young Spiders, especially Thomisi and Epeiræ. It is also probable that many of

* After all the observations which have been made upon the coupling of spiders, I am induced to believe these appendages are organs of generation. I have in vain sought for any ventral organs, in a large male Mygale, preserved in spirits. We ought not always to decide upon analogy—for instance, the female organs of Glomeris and Julus are situated near the mouth—a fact of which there is no second example.

† The expression *cephalothorax* would be more correct, but it is not in common use. Neither do I use the term *corselet*, which is generally used, because it is ordinarily also applied to a portion only of the thorax, namely, the prothorax, in Coleopterous and Orthopterous insects.

‡ These orifices are upon the terminal joint, which is often withdrawn. If pressed sharply, a number of minute papillæ, pierced at the tip (which are the real spinnerets), are protruded. Some naturalists are of opinion that the two small nipples placed on the middle of the four others do not supply silken threads.

§ This joint, the first of the tibia, is a kind of rotule.

these Spiders, not having a sufficient supply of silk, merely emit single threads, such, for instance, as those made by young Lycosæ, which are to be seen in great abundance crossing from ridge to ridge in cultivated lands, when they reflect the sun's rays. When chemically analyzed, they are found to exhibit precisely the same characters as the silk of Spiders, and are, therefore, not formed in the air, as has been conjectured by Lamarck. Gloves and stockings have been made with spiders' silk; but these attempts, not being capable of a general application, and being subject to great difficulties, are more curious than useful. The material is, however, far more important for the Spiders themselves. It is by its means that the sedentary species, or those which do not chase after their prey, construct their webs of a more or less firm texture, capable, in some exotic species, of holding small birds, and of which the forms and positions vary according to the habits peculiar to each species, and which are so many snares in which the insects which serve them for food are captured. Scarcely is one caught by the hooks of the tarsi, than the Spider, sometimes placed in the centre of its web, or in a cell near one of its angles, darts forth, approaches the insect, uses all its efforts to wound the captive with its murderous darts, and to discharge into the wound an active poison. When it opposes too strong a resistance, and a struggle may be dangerous to the Spider, the latter retires for a time, until it has lost its strength, and becomes still more entangled in its ineffectual efforts to escape, when, there being no longer cause for alarm, the Spider returns, and endeavours to twirl it round, weaving, at the same time, around it a strong silken web, in which it is sometimes entirely encased.

Lister states that the Spiders discharge their threads in the same manner as the Porcupine is fabulously asserted to do, with this difference, that the threads of the Spider remain attached to its body. This fact has been considered impossible. We have, however, seen the threads issue from the nipples of some Thomisi, extending in a straight line, and forming moveable rays when the animal moves them circularly. Another use of silk common to all female Spiders is, for the construction of cocoons destined for the inclosure of the eggs. The contexture and the form of these cocoons are varied according to the habits of the various races of Spiders. They are generally spheroid; some have the shape of a cap or a flat sphere; some are placed on a peduncle, and others are terminated by a club. Other matters, such as earth, leaves, &c., sometimes cover them, or at least partially; a finer tissue often envelops the eggs in the inside, where they are loose or agglutinated together, and are more or less numerous. [Then follows a long passage relative to the presumed use of the male palpi as organs of generation, to which a note is added, that they may at least be considered as exciting organs.] From the experiments of Audebert, it appears that a single fecundation is sufficient for several successive generations; but, as in all insects and other analogous classes, the eggs are sterile if the sexes have not coupled. The first-laid eggs are hatched before the end of the autumn; the others remain through the winter unchanged. It has been observed that the females of some species of Lycosæ tear open their egg-cases when the young are ready to come forth, and the young, when first hatched, mount upon the back of their parent, where they remain for a considerable time. Other female Spiders carry their cocoons beneath the breast, or station themselves near them to act as guards. The two fore-legs are not developed in the young of some species until some days after their birth. Others, during this period, assemble themselves in society, appearing to spin a common envelope. Their colours are at this period more uniform, so that the inexperienced naturalist is liable to err in multiplying the number of species. M. Saint Fargeau has observed that these animals possess, as well as the Crabs, the power of renewing their lost limbs.

I have ascertained that a single bite of a moderate-sized spider will kill a house-fly in a few minutes. It is further certain that the bite of the great American Spiders, called Crab Spiders, belonging to the genus *Mygale*, kill small vertebrated animals, such as humming birds, pigeons*, &c., and may even cause in Man a violent increase of fever; even the wound of some of our southern [French] species has proved fatal. Without believing all the fables of Baglivi and others as to the powers of the Tarantula, we may dread the bite of the larger species of Spiders, especially those of warm climates. Some species of Sand-wasps (genus *Sphex*, Linn.) seize upon Spiders, which they wound, and then bury in burrows, in which they also deposit their eggs, in order that they may serve as food for the young when hatched. The majority of these animals die in the autumn, but others live through several seasons, including Mygale, Lycosa, and probably others. Although Pliny asserts that the Phalangiums

* [See the supplemental observations on the genus Mygale, as to the origin of this widely-spread error.]

were not known in Italy, we consider with Mouffet that the Lycosæ, and other large Spiders which do not construct webs, as well as the Solpugæ, are the animals collectively known under the former name, and of which several species were described by the ancients. Lister, who first studied the Spiders which inhabit Great Britain with great care, laid the base of a natural distribution, of which those more recently published are mostly only modifications; our more recent acquaintance with some species peculiar to warmer climates, such as as the Mason Spider, described by Sauvages, and other analogous species, the employment of the organs of the mouth, introduced by Fabricius, a more precise study of the eyes and their relative sizes, and the relative length of the legs, have contributed to perfect their arrangement. M. Walckenaer has entered into very minute details relative to these animals, so that it is difficult to detect a species which will not enter into the groups which he has proposed. The presence or absence of a third unguis at the extremity of the tarsi affords another character not yet sufficiently generalized, of which, however, Savigny has given a slight sketch (see Walckenaer, *Faun. Franç.*, note at the end of the genus Attus).

M. L. Dufour, who has published excellent memoirs upon the anatomy of these insects, and especially studied those of the kingdom of Valencia, where he has discovered many new species, has paid particular attention to the respiratory organs of the Arachnida, and it is after his remark that we divide them into those which have four pulmonary sacs, with four external spiracles, two on each side close together, and those which have only two.*

The first of these groups, which includes the *Araneides theraphoses* of Walckenaer, and some genera, for which he has employed the collective name of *Aranea*, compose, in our method, the single genus—

MYGALE.

The eyes are always situated at the anterior extremity of the thorax, generally close together. The chelicerae and legs are robust. The majority have only four spinnerets†; the two lateral ones are situated rather above the two others, and are longer and 3-jointed, not computing the elevation which forms their footstalk. They form silken tubes for their abode, which they hide either in the earth into which they have burrowed, or under stones, in the bark of trees, or amongst the leaves.

The *Theraphoses* of Walckenaer form a first division, characterized by four spinnerets, the two intermediate and inferior generally very short, and the two exterior much exserted; the hooks of the chelicerae folded beneath, along the under side, and not along the inner surfaces. Eight eyes in all, generally arranged upon a small eminence, three on each side, forming a reversed triangle, of which the two upper ones are close together; the two others in a line between the preceding. The fourth pair of legs and then the first pair are the longest, the third the shortest.

Those species which have the palpi inserted at the superior extremity of the maxillæ so that they appear to be six-jointed, the basal joint being long and narrow, and acting as the maxilla; the tongue, always small, and nearly square, and the two fore tibiæ of the males with a strong spine beneath at the tip, form the restricted genus—

Mygale, Walck.,—some of which have not a transverse series of moveable, corneous spines at the upper extremity of the cheliceræ, above the place of insertion of the terminal hook. The hair on the under-side of their tarsi forms a thick cushion, generally hiding the ungues. These are the largest species of the family, some

* [The arrangement of the Spiders given by M. Walckenaer, in his last work, above referred to, differs in some respects from that employed by Latreille. The following is an abstract of his tabular synopsis:—

			Genera.	Groups arranged according to the nature of their nests.		
Theraphoses	Eight eyes	Eyes near together	Mygale, Filistata, &c.	Latebricoles	Vagabondes	Terrestres.
		Eyes apart	Missulena			
Araignées	Six eyes	Eyes frontal	Dysdera, &c.	Tubicoles		
		Eyes frontal and lateral	Uptiotes, &c.	Cellulicoles		
	Eight eyes	Eyes frontal and lateral, unequal	Lycosa, Dolophones, &c.	Coureuses		
			Eresus, Attus, &c.	Voltigeuses		
		Eyes frontal, equal-sized	Thomisus, Sparassus, &c.	Marcheuses		
			Clubiona, &c.	Niditeles	Errantes	
			Pholcus, &c.	Filiteles		
			Tegenaria (Aranea), &c.	Tapiteles	Sedentaires	
			Epeira, &c.	Orbiteles		
			Linyphia	Napiteles		
			Argus, &c.	Retiteles		
			Argyroneta	Aquiteles	Nageuses	Aquatiques.]

[Mr M'Leay, in an article upon some new forms of Arachnida, published in the *Annals of Natural History*, has thrown doubts upon the general character given of these groups, figuring one species with only two eyes (*Nops Guanabacoæ*); another, with the sternum divided into three distinct segments, and one pair of the eyes enormously large (*Deinopis Lamia*); another with the head, thorax, and abdomen apparently articulated (*Myrmarachne melanocephala*); and another with the fore-legs modified, in structure short, thickened, and composed of only six instead of seven joints (*Otiothops Walckenaeri*).]

† I have observed in Atypus the vestiges of two other nipples, being those which in the Spiders of the following division are placed between the four exterior ones, and are very visible; but as they are here scarcely apparent, I have not counted them as such.

of which, in a state of repose, occupy a circular space of six or seven inches in diameter, and [are a.serted] to seize Humming-birds. They form their nests in the slits of trees, beneath the bark, in the cavities of stones and rocks, or on the surface of leaves of various vegetables. The cell of the *M. avicularia* is in the shape of a tube, narrowed into a point at its posterior extremity. It is composed of a white web of very fine texture, semitransparent, like muslin. M. Goudot gave me a nest which was about seven or eight inches long, and about two inches broad. The cocoon of this species had the size and shape of a large nut. Its envelope, formed of the same materials as the nest, consists of three layers. It appears that the young are there hatched, and undergo their first moulting. This naturalist informs me that he has obtained as many as a hundred young ones from one cocoon. (See my memoir on the habits of the *Mygale avicularia*, Lin., in those of the *Mus. d'Hist. Nat.*, tom. vii. p. 456.) The body of this species is about an inch and a half long, black, and very hairy, with the tips of the palpi, legs, &c., reddish.

South America and the Antilles also furnish other species, which are known to the French colonists under the name of Spider-Crabs, and of which the bite is reputed very dangerous. There is also a large East Indian species (*M. fasciata*, Seba); and a species is brought from the Cape of Good Hope, nearly as large as *M. avicularia*. Another species (*M. valentina*) has been discovered in the arid deserts of Moxenta, in Spain, by M. Dufour; and another, from the same country, has been described by Walckenaer (*M. calpeiana*). These two species form a particular group, having the ungues exposed. (See further our articles on this and the allied genera in the *Nouv. Diction. d'Hist. Nat.*, second edition.)

The other species of Mygale (forming the genus *Cteniza*, Latr., in *Fam. Nat.*) have a transverse row of moveable corneous spines at the superior extremity of the basal joint of the chelicera. The tarsi are less hairy beneath than in the preceding, and their ungues are always exposed. They construct, in dry shelving situations exposed to the sun, in the southern parts of Europe, &c., subterranean cylindrical galleries, often two feet deep, and so tortuous that the traces of them are often lost. They moreover construct, at the entrance, a moveable lid formed of silk and earth, fixed by a hinge, and which, by its precise size, inclination, and weight, closely shuts the opening, scarcely so as to permit the place of the nest to be distinguished from the neighbouring soil. The inner surface of the lid is lined with silk, which enables the animal to hold it down, and prevent its being pulled open. When taken by violence from its nest, the Mygale is stupid, and offers no resistance. A silken tube, forming the nest, lines the interior of the gallery. M. Dufour is of opinion that the males do not make these burrows, being generally found under stones, and appearing less favoured with organs fitted for those works. We presume, with M. Dufour, that our *M. carminans* is only the male of *M. cæmentaria*, Latr., although M. Walckenaer is of a different opinion. The latter species, described by Sauvages under the name of the Mason-Spider (*Hist. de l'Acad. des Scienc.*, 1758), and by Dorthes under that of the Mining-Spider (*Linn. Trans*,. vol. ii. 17, 18), is about two-thirds of an inch long, and is found in the southern departments of France, Spain, &c. Another species (*M. fodiens*, Walck., *M. Sauvagesii*, Duf., Rossi), is rather larger than the preceding, and inhabits Tuscany and Corsica. The Muséum d'Histoire Naturelle possesses a block of earth in which four of its nests are arranged in a regular square. [M. V. Audouin has published a long account of these nests in the *Annales de la Société Entomologique de France*.] M. Lefebvre has also brought another distinct species from Sicily, and another is found in Jamaica, (*M. nidulans*), which, together with its nest, has been figured by Brown in his Natural History of that island, pl. 44, f. 3.

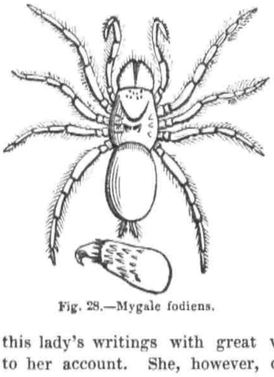
Fig. 28.—Mygale fodiens.

[It is to Madame Merian that we owe the origin of the story that the large American Mygale attacks and kills small birds; this lady, in her splendid work on the insects of Surinam, not only asserting this, but figuring the Spider in the act of feeding on a Humming-bird which it had dragged off its nest. Hence originated the idea that the Mygale spun the webs which are met with in tropical climates, of sufficient force to hold small birds, but which are the production of a species of *Epeira*. Mr. MacLeay, in the first volume of the *Transactions of the Zoological Society*, has attacked this lady's writings with great violence, giving her credit for all that subsequent compilers chose to add to her account. She, however, did not assert that the Mygale forms these webs, nor is such the case, for that spider lives in holes under ground, and in all its movements keeps close to the earth, its food consiting of Iuli, subterranean Crickets, and Cockroaches. On a living Humming-bird being placed into its hole by Mr. MacLeay, the Spider even quitted it; whence he disbelieves the existence of any bird-catching Spider; but M. Moreau de Jonnès expressly mentions that it climbs the branches of trees to devour the young of Humming-birds, &c. Latreille published an elaborate memoir upon this genus in the *Nouvelles Annales du Muséum*, vol. i., and more recently M. Walckenaer has described thirty-six species of this genus in his *Histoire Naturelle des Insectes Aptères*.

The *M. nidulans*, which is sufficiently abundant in the West Indian islands, has been figured, together with its nest, by Mr. Kirby in his Bridgewater Treatise. It is also figured in Griffith's translation of the *Règne Animal*, but regarded as an undescribed species, named *N. nitida*. Mr. Sells has communicated some curious observations on it and its nest to the Entomological Society of London.]

Those species (of *Theraphoses*) which have the palpi inserted on an inferior dilatation on the outside of the maxillæ, and 5-jointed; the tongue very small in Atypus, but which becomes longer and advanced between the maxillæ in the following genera, which is its general character; the last joint of the palpi in both sexes long and

narrowed to a point at the tip; the males not having a strong joint at the extremity of the anterior tibiæ,—constitute the following genera:—

Atypus, Latr., *Oletera*, Walck., having a very minute tongue, and the eyes placed close together upon a tubercle. Type, *A. Sulzeri*, Latr., *Aranea picea*, Sulzer, about two-thirds of an inch long, and anteriorly of a blackish colour. This species burrows, in shelving ground, covered with turf, a cylindrical cell, curved below, lined with a white silken tube. The egg-case is affixed by silken threads attached to each end, to the bottom of this tube. It is found in the vicinity of Paris, Bordeaux, &c. M. Milbert has sent another species, found in the neighbourhood of Philadelphia.

Fig. 29.—Atypus Sulzeri.

Eriodon, Latr., *Missulena*, Walck., has the tongue long and narrow, and the eyes dispersed on the front of the thorax. *E. occatorius*, Latr., from New Holland.

Chalinura, Dalm., has the eyes placed on a very elevated frontal tubercle; four of these (the two anterior being very large) occupying the centre; the external spinnerets are very long. Founded on a species observed by Dalman, in Copal.

Our second and last division of the quadripulmonary Spiders (or genus Mygale) is characterised, as in Eriodon, by a narrow tongue, prolonged between the maxillæ, and by 5-jointed palpi, but the hooks of the chelicerræ are folded upon their inner face; they have six spinnerets; the first pair of legs, and not the fourth, is the longest, and the third the shortest. Some have only six eyes. The number of their pulmonary sacs does not allow us to separate this subdivision from the preceding; as they lead to Drassus, Clotho, and Segestria, which have only two pulmonary sacs, the natural order does not permit us to pass from Mygale to the chasing Spiders, *Lycosa*; Mygale, in fact, consists of weaving Spiders, and it is in this division that *A. avicularia* was originally placed by Linnæus.

Dysdera, Latr., has six eyes, arranged in a horse-shoe, with the open part in front; the chelicerræ very robust and advanced, and the maxillæ straight and dilated at the insertion of the palpi. Type, *D. erythrina*, Latr., Walck., [France, England. The Spiders of this and a new allied genus (*Oonops*) have formed the subject of a memoir, published by R. Templeton, Esq., in the last volume of the *Zoological Journal*.]

Filistata, Latr., has eight eyes, arranged on a small elevation at the anterior extremity of the thorax; the chelicerræ are small, and the maxillæ curved on the outer edge, and forming an arch round the tongue. Type, *T. bicolor*, Latr., France. Another species is found at Guadaloupe, differing in having longer legs, &c.

We now pass to those species of Spiders which have only a pair of pulmonary sacs and spiracles. All the following species possess 5-jointed palpi, inserted on the outer edge of the maxillæ, near to the base, and often in a notch, the tongue produced between them, and either square, triangular, or semicircular, and six spinnerets at the anus. The last joint of the palpi of the males is more or less ovoid, and enerally incloses in an excavation a very complicated sexual organ, but in Segestria it is simple. With the exception of a very few species, entering into the genus Mygale, they compose that of

ARANEA, Lin. (*Araneus* of some authors),

[Which Latreille divides into two principal groups, according to their sedentary or wandering habits.] The first division comprises the sedentary Spiders, which construct webs, or at least throw out threads for the capture of their prey, and generally station themselves upon or near their webs as well as near their eggs. Their eyes are close together, upon the broad part of the forehead, sometimes eight in number (four or two being in the middle, and the others at the side), or sometimes only six. [This division comprises two subdivisions, the Rectigrades and the Laterigrades.]

The first of these subdivisions comprises those species which always walk straight forwards, whence are named RECTIGRADES: they weave close webs, upon which they remain stationary, with their legs elevated in repose. Sometimes the two anterior and the two posterior are longest, and sometimes the four anterior, or the fourth and the third pairs. The eyes are not arranged in a crescent.

We may divide these into three sections [the *Tubiteles*, *Inequiteles*, and *Orbiteles*].

The TUBITELÆ, or Tapestry-weavers, have cylindrical spinnerets, placed close together in a bunch directed backwards. The legs are robust, with the anterior or posterior pair largest in some, but all the legs of nearly equal size in the others.

In the two following subgenera, the maxillæ form an arch round the tongue, thus approaching Filistata, and receding from the following. The eyes are always eight in number, arranged four and four in two transverse lines.

Clotho (Walck., *Uroctea*, Dufour,) a singular genus, with very small chelicerræ, capable of being but slightly extended, without teeth, with very small hooks, the body short, legs long, and scarcely varying in relative length; the eyes are close together, and arranged in the same manner as in *Mygale*, Walck., three on each side, forming a curve, with the two other larger ones in a line between them; the maxillæ and tongue are proportionably short;

the former have a slight dilatation on the outside, the latter is triangular; the two upper spinnerets are long; but, according to L. Dufour, instead of the two intermediate spinnerets there are two comb-shaped valves,—but I have distinctly seen in a well-preserved specimen six spinnerets, the two superior being the largest, and four others very small: the anus on each side is furnished with a pencil of retractile hairs, which L. Dufour has called comb shaped valves, and which are distinct from the intermediate spinnerets.

The only species, *Ur. 5-maculata*, Dufour (*Cl. Durandi*, Latr.), is about half an inch long, of a brown maroon colour, with the abdomen black, marked with five yellowish spots. Found in the south of Europe and Egypt. Dufour has made some curious observations on its habits. It constructs on the under side of stones, or in crevices of rocks, a cocoon in the shape of a cap or patella an inch in diameter, its circumference having seven or eight festoons; the points alone being fixed to the stone by means of threads, whilst the edges of the festoons are free. This singular tent is of an admirable texture, the outer surface resembling the finest taffety, and composed of a number of folds. When young it only constructs two layers, between which it takes its station. But subsequently, perhaps at each moulting, it adds additional folds, and when the period of reproduction arrives it weaves another apartment expressly for the reception of the sacs of eggs and young when hatched, of a softer texture. The inside of its habitation is always singularly clean. The bags in which the eggs are placed are four, five, or six in number in each habitation; they are about one-third of an inch in diameter, and of a lenticular form. It is not until the end of December or January that the eggs are deposited, and they are enveloped in fine down to guard them from the cold. The edges of the festoons not being fastened together, the insect is able to creep in and out at will by lifting them up. When the young are able to dispense with the maternal cares, they quit their common habitation and form separate abodes, and their parent dies in her tent, which is thus the birthplace and tomb of the Uroctea.

Drassus, Walck., has robust chelicerae, toothed beneath, the maxillæ truncated obliquely at the tip, and the tongue oval, truncated beneath; the line formed by the four posterior eyes is longer than that of the four anterior ones, the proportions of the external spinnerets scarcely differ, and they have not the comb-shaped valves which exist in Clotho; the fourth and then the fore-pairs of legs are evidently longer than the others. They take their stations under stones, in holes of walls, the interior of leaves, and form cells of a very white silk. The cocoons of some are orbicular, flattened, and composed of two valves applied against each other. M. Walckenaer distributed the species into three families, from the lines of the eyes and form of the maxillæ. *D. viridissimus*, which alone comprises his third division, forms on the surface of leaves a fine, white, and transparent web, beneath which it resides. I have often found on one of the surfaces of pear-leaves a similar web, but angular at the edge, like a tent, similar to that of Clotho, and which is, I presume, formed by this species.

M. Dufour found another species under stones upon the highest Pyrenees (*D. segestriformis*). It is allied to my *D. melanogaster*, which is probably the *D. lucifugus*, Walck. A very pretty little species is common near Paris, running on the ground; it is nearly cylindrical, with a fulvous thorax, covered with purple down; the abdomen varied with blue, red, and green metallic tints, with golden lines or spots (*D. relucens*).

In all the other Tubitelæ the maxillæ do not form an arch round the tongue: they are dilated on the outside, beneath the base of the palpi.

Segestria, Latr., has only six eyes, four in a curved line, and two behind the two lateral ones. The tongue is nearly square and oblong; the first and then the second pair of legs are of the greatest length. These Spiders spin in the holes of walls cylindrical silken threads, where they station themselves, with their fore-legs extended in front, diverging threads extended around the mouth of the tube, and form a small web for catching insects. *S. perfida*, Latr., *Aranea florentina*, Rossi, and other species.

The other Tubitelæ have eight eyes; and in consequence of the medium in which they reside, they may be divided into terrestrial and aquatic species. Although M. Walckenaer has formed the latter into his last family of the Spiders (that of *Nayades*), they have so much relation with the other Tubitelæ that notwithstanding this difference in their habits they ought to be united with them. In the terrestrial species the tongue is nearly square, or but slightly narrowed and truncated at the tip, the maxillæ straight or nearly straight, and more or less dilated at the tip; the two eyes at each side of the ocular group are separate and not geminated, as in the aquatic Tubitelæ.

Clubiona, Latr., differs from the next in the relative length of the external spinnerets, and in the front line of eyes being nearly straight. They make silken tubes to reside in, which they place under stones, in crevices of walls, or between leaves. The cocoons are globular (*A. holosericea*, Lin.; *A. atrox*, De Geer.)

Aranea, which at first we had named *Tegenaria*, still retained by M. Walckenaer, and to which we unite his *Agelenæ* and *Nyssi*, has the two upper spinnerets evidently larger than the others, and the front line of the eyes forms a curve. They construct in the interior of our habitations, in the angles of walls, upon plants and hedges, in the ground or under stones, large webs [cobwebs] nearly horizontal, and at the upper part of which is a tube in which they station themselves, without motion (*Aranea domestica*, Linn.; *Tegenaria civilis*, Walck.; *Ar. labyrinthica*, Linn., &c.)

Argyroneta, Latr. (comprising the *Nayades*, Walckenaer; or *Tubiteles aquatiques*, Latr.) has the maxillæ inclining upon the tongue, which is triangular. The two eyes at each lateral extremity of the ocular group are placed close together on a particular eminence; the four others form a square. *A. aquatica*, Linn. [or diving Water-spider] is blackish-brown, with the abdomen darker coloured, silky, and with four impressed dots on the back. It resides in standing water, in which it swims with the abdomen encased in a bubble of air, and in which it forms for its retreat an oval cell filled with air and formed of silk, from which threads proceed to the different adjacent water-plants in all directions. Here it devours its prey, constructs its egg-case, which it carefully guards, and passes the winter, having first closed the cell.

The second section of the sedentary and rectigrade Spiders—that of the INEQUITELÆ or Spinning Spiders (*Araignées filandières*), has the external spinnerets nearly conical, very slightly exserted, convergent, arranged in a rosette, and the legs very slender. The maxillæ incline towards the tongue, and are narrow at the tip, or at least are not dilated. The majority have the first pair of legs, and then the fourth, the longest; the abdomen is larger, softer, and more coloured than in the preceding tribes. They construct webs with irrregular meshes composed of threads, which cross in all directions and different surfaces. They whirl threads round their prey, take great pains in the preservation of their eggs, and do not leave them until they are hatched. They live but a short time.

Scytodes, Latr., has only six eyes, arranged in pairs, and the ungues of the tarsi are inserted upon a supplemental joint. *S. thoracica*, Latr., inhabits the interior of our apartments; another species, *S. rubescens*, was found by Dufour in the mountains of Valencia. It fabricates an irregular tube of slender texture, of a milky-white, like that of *Dysdera erythrina*.

Theridion, Walck., has eight eyes thus arranged, four in the middle in a square, the two anterior ones placed on protuberance, and two on each side, also placed on an elevation common to both; the thorax is like a reversed heart, or nearly triangular. The species are very numerous. Type, *Aranea 13-guttata*, Fabr., Rossi.—Found in Tuscany and the island of Corsica. Its bite is considered very venomous, and even mortal.*—(See the *Tableau* and the *Histoire des Araneides* of Walckenaer; the *Annales des Sci. Natur.*, and the *Ann. des Sci. Physiq.*)

A. mactans, Fab., an American species, is similarly dreaded. These fears seem more to originate in the black colour of the animals, which are marked with blood-coloured spots. *T. benignum*, Walck., takes up its abode in bunches of grapes, and thus defends them from the attacks of other insects.

Epirinus, Walck.,—has also eight eyes, but which are placed close together upon a common elevation of the narrow and subcylindric thorax. *E. truncatus*, Latr. Paris, Italy.

Pholcus, Walck.,—has the first and then the second legs the longest; the eyes, eight in number, are placed upon a tubercle, and arranged in three groups, one on each side composed of three eyes placed in a triangle, and the two others in the middle, in a transverse row. *Ph. Phalangioides*, Walck., has the body long and very narrow, of a very pale livid colour; abdomen very soft, and marked above with blackish spots; legs extremely long and very slender, with a white ring at the tip of the thighs and tibiæ. It is common in houses, where it spins a web composed of loose threads in the angles of walls. The female gums her eggs into a rounded naked body, which it bears about in its jaws. Dufour found another species in the crevices of rocks in Valencia. Like the preceding, it balances itself backwards and forwards upon its very slender feet.

The third section of the sedentary rectigrade Spiders is that of the ORBITELÆ, or the *Araignées tendeuses* of some authors, having the external spinnerets nearly conical, slightly exserted, convergent and arranged in a rosette, the legs slender, and the maxillæ straight or sensibly widened at the tip; the first pair of legs, and then the second, are always the longest. The eyes are eight in number, and thus arranged,—four in the middle in a square and the two others on each side. They resemble the Inequitelæ in the size, softness, varied colours of the abdomen, and shortness of their lives; but they make their webs with regular meshes, arranged in concentric circles crossed by straight radii extending from the circumference and meeting in the centre, where the insects remain stationary and in a reversed position. Some species secrete themselves in a cavity or cell which they construct near the edges of the net, which is sometimes horizontal and sometimes perpendicular. The eggs are agglutinated together, very numerous, and inclosed in a large cocoon. The threads which support the web, and which stretch to about a fifth their length, are used for the divisions of the micrometer, an astronomical instrument, as we learn from M. Arago.

Linyphia, Latr., has four of the eyes in the middle, forming a trapezium widest behind; the two hinder eyes being larger than the rest, and the four others, arranged in two pairs, one on each side and in an oblique direction. The maxillæ are dilated at the tip. *L. triangularis*, Walck.; *Aranea montana*, Linn., &c. They construct upon various shrubs an horizontal slender web, attached by irregular threads in many points; this web is thus a melange of those of the *Inequitelæ* and *Orbitelæ*. The insect stations itself on the under side in a transverse position.

Uloborus, Latr., has the four posterior eyes placed at equal distances in a straight line, and the two lateral ones of the front line nearer the front edge of the thorax than the two intermediate ones. The maxillæ widen from near the base, and are spatulated at the tip; the tarsi of the three hind pairs of legs are terminated by a single unguis. The body is long and subcylindrical. When stationed in the middle of their web, they stretch their four fore-legs forward in a straight line, and their two hind ones in an opposite direction, the third pair being laterally extended. They make webs like the other Orbitelæ, but looser and horizontally. The cocoon is narrow, long, angular at the sides, and suspended vertically by one end to a net; the other end is produced into two points, as stated to me by M. Dufour. *U. Walckenaerius*, Lat.; found in the woods of the environs of Bordeaux, and other southern departments; five lines long.

* This species is the type of Walckenaer's genus Latrodectes, founded upon supposed differences in the relative length of the legs.

Tetragnatha, Latr., has the eyes arranged, four and four, in two lines nearly parallel, and separated by nearly equal intervals; the maxillæ long, narrow, and dilated only at the upper end, and the chelicerræ are very long, especially in the males: the web is vertical—*T. extensa*, Walck., Linn.

Epeira, Walck., has the two eyes on each side close together, and the four middle ones forming a square. The maxillæ are dilated from the base, and form a rounded palette. *E. cucurbitina* is the only known species of which the web is horizontal; that of all the others is vertical or inclined.

Some species place themselves in the centre with the head downwards; the others make in its vicinity a sma cell, either arched over, sometimes in the form of a silken tube, and sometimes composed of leaves brought together and attached by threads, or opened above like a bird's nest. The webs of some exotic species are composed of threads sufficiently strong to catch small birds, and even to annoy man when he may happen to come into contact with them. The egg case is generally globular, but that of some species is of an oval figure truncated at one end, or resembling a very short cone. The natives of New Holland (*Voyage à la recherche de La Perouse*, p. 239) and of some of the South Sea Islands, when in want of other food, devour a species of Epeira, early allied to *E. esuriens*, Fabr.

M. Walckenaer mentions sixty-four species of Epeira, generally remarkable for the variety of their colours, forms, and habits. He has distributed them into various small and very natural families, of which we have endeavoured to simplify the study in the 2nd edition of the *Nouv. Dict. d'Hist. Nat.*, article *Epeira*. Various important considerations, however, such as the characters of the sexual organs, have been neglected or not sufficiently studied. The most interesting species are

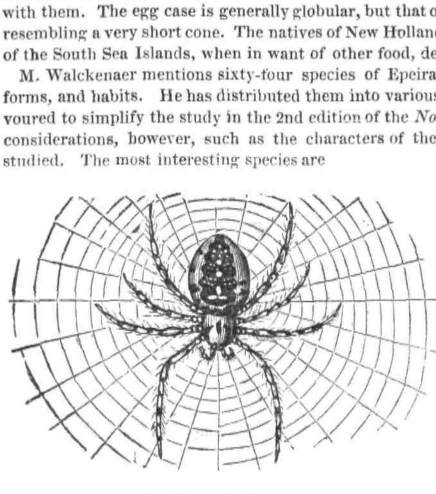

Fig. 30.—Epeira diadema.

Epeira diadema, Lin.—This is of a large size, with the abdomen marked with a triple cross formed of small white spots; it is very abundant in autumn. The eggs [which the parent deposits at the commencement of the cold weather, in angles of the ceilings of rooms, passages, &c. near gardens, enveloping them with a loose white silken web] are hatched in the spring of the following year.

E. ventricosa, De Geer, has the abdomen flattened, of a greyish-brown or obscure yellowish colour, with a black band margined with grey down the middle of the back, and eight or ten impressed dots. It spins its web against walls or other bodies, and hides itself in a nest of white silk, which it constructs beneath some prominence, or in some cavity in the neighbourhood of its web. It neither works nor feeds except during the night, or when there is but little day-light.

E. fasciata, Walck., has the thorax covered with a thin silvery pubescence; the abdomen is of a fine yellow with black transverse lines. Its cocoon is about an inch long, and resembles a small balloon; of a grey colour, with longitudinal black ribs, with one of the extremities truncated, and closed by a flat silken lid. The interior exhibits a very fine down, which envelopes the eggs. This species is found at the edges of running water, where it spins a vertical web, of a very regular construction, in the centre of which it stations itself. M. Dufour has given a very detailed account of this species, and of its habits, (*Ann. Sci. Physiq.* tom. vi.,) and has for the first time described the male, [which is exceedingly small, compared with the female.] [The egg cocoon of this species is described and figured in the *Field Naturalist's Magazine*, vol. ii. p. 57.]

Epeira cucurbitina, Lin., *A. senoculata*, Fabr., spins its web of small extent in a horizontal position, amongst the stems and leaves of plants.

Epeira opuntiæ, Dufour, constantly stations itself amongst the leaves of the agave and opuntia in Catalonia and Valencia in Spain, where it constructs its net with loose and irregular meshes. Its cocoons are oval and of a whitish colour, composed of two coats, the interior of which envelopes the eggs.

Amongst the exotic species some are very remarkable. Some of them have the abdomen cased with a very solid skin, armed points, or horny spines, (*A. militaris*, *spinosa*, *hexacantha*, *tetracantha*, &c., Fabr.: *E. curvicauda*, authier, (*Ann. Sci. Nat.* tom. i.) has the abdomen dilated behind and armed with two extremely long, curved, ender spines. These spined species ought to form a distinct subgenus, [*Gasteracantha*, Latr., in *Cours Entomologie*].

Other exotic species of Epeira have bundles of hairs upon the legs, (*A. pilipes*, *clavipes*, Fabr.) Dr. Leach forms a genus *Nephisa* with one of these species, named *N. maculata*.

We now pass to Spiders, sedentary like the preceding, but which are able to walk sideways, backwards, forwards—in fact, in any direction. These form the section of the Laterigrades. The four fore-legs are always longer than the others; sometimes the second pair exceeds the first, but sometimes they are equal to them; the animal stretches them out, throughout their entire length, upon the surface upon which it is stationed. The chelicerræ are generally small, and their hook is folded transversely, as in the four preceding tribes; the eyes are always eight in number, often very unequal, and form, by their union, a segment of a circle or crescent; the two lateral posterior ones are placed further backwards and nearer to the sides of the thorax than the others. The maxillæ are in a great

number inclined towards the tongue. The body is generally depressed, like a Crab, with the abdomen broad, rounded, or triangular.

These Spiders keep themselves immovably fixed, with the legs stretched out, upon vegetables. They do not make webs, merely throwing out a few solitary threads in order to catch their prey. The cocoon is orbicular and flattened; they hide it between the leaves of plants, of which they bring the edges into contact, guarding it carefully until the birth of the young.

Micrommata, Latr., *Sparassus*, Walck.,* has the maxillæ straight, parallel, and rounded at the edge, the eyes arranged into two rows, the posterior row being the longest, and curved behind; the tongue is semicircular *M. Smaragdula*, Fab., *A. viridissima*, De G., of a grass-green colour, with the abdomen yellowish-green, with a darker line. Found common in woods near Paris, where it fastens three or four leaves together into a triangular pocket, lining the interior with thick silk, placing its cocoon in the middle, which is round and white, and permits the eggs to be perceived within; these are not glued together.

M. Argelas (the name of which reminds naturalists of that of one of our most zealous savans, whom I have held up to their esteem as my deliverer in the revolutionary troubles), is one of our largest [French] species, being two-thirds of an inch long. This species was discovered near Bordeaux, by the naturalist to whom I have dedicated it. Subsequently, M. Dufour discovered it in the most arid mountains of Valentia, where he observed its habits. It runs with velocity, extending its legs laterally, its unguicular cushions permitting it to retain its station on the smoothest surfaces and in every situation. Its cocoon (which it constructs on the under side of pieces of rock) resembles that of *Clotho Durandi*. It also secretes itself there against inclement weather and its enemies, and in order to deposit its eggs. This is an oval tent, nearly two inches in diameter, fastened upon the stones, nearly like marine patellæ. It is composed of an outer envelope of yellowish taffety, thin, like the peel of an onion, but resisting; and of an inner covering, more pliant, soft, and open at both ends. It is by these apertures, furnished with valves, that the animal goes out. The cocoon is globular, placed underneath its abode, so that it can cover it, and contains about sixty eggs.

I believe we must also place in this genus the *Aranea venatoria*, Linn., figured in *Sloane's Jamaica* (pl. 225, fol. 2; Nhamdia, 2? Pison), and another species from East India, very like the preceding, and which we see figured upon the drawings and tapestry imported from China.

Senelops, Dufour, has the maxillæ straight, without a lateral notch, and terminating in a point, being obliquely truncate; the tongue is semicircular. The eyes are thus arranged,—six in front, forming a transverse [tortuous] line, and two others, posterior, and situated, one on each side, behind each extremity of the preceding line; the legs long, and the second pair the longest, and then the third and fourth, which are longer than the first. *S. omalosoma*, Dufour, Valencia, inhabiting the rocks, and running with the quickness of a dart; also in Syria. Other species occur in Senegal, the Cape of Good Hope, and Mauritius.

Philodromus, Walck., has the maxillæ inclined upon the tongue, which is longer than broad; the eyes, at nearly equal distances apart, form a crescent or semicircle, the lateral ones not being placed upon tubercles or eminences. The chelicerae are long and cylindrical; the four or two hind legs do not materially differ in length from the preceding. According to M. Walckenaer, these spiders run with rapidity, the legs laterally extended, watch for their prey, throw out single threads for its retention, and hide themselves in holes, or amongst the leaves, which they draw together when they deposit their eggs.

Some species have the body flat and broad, the abdomen short, dilated behind, with the four middle legs longest. Such is *Ph. margaritarius*, Clerck, which is three lines long, and is very common upon trees, wooden fences, walls, &c., where it sits with its feet extended; when watched it escapes with great rapidity, or falls to the ground by dividing the thread by which it was held. Its cocoon is of a fine white, and incloses about a hundred eggs, which are yellow and loose. It is placed in the crevices of trees or posts exposed to the north, and is very carefully guarded.

The other species of Philodromus, which Walckenaer forms into several small groups, have the body, and often the chelicerae, proportionably longer. The abdomen is pear-shaped, or oval, and sometimes cylindrical. The second pair of legs, and then the first or the fourth, are longest. *Ph. rhombicus*, Walck.; *Ph. oblongus*, Walck., &c.

Thomisus, Walck., differs from Philodromus in the chelicerae, proportionably shorter and wedge-shaped, and the four posterior legs very evidently shorter than the four anterior. The lateral eyes are often placed on tubercles, while those of Philodromus are always sessile. The species of this genus are commonly called Crab-spiders. The males are very different in their colours from the females, and generally much smaller.

Some species (all of which are exotic) have the eyes arranged in two transverse, nearly parallel lines, four and four, the posterior line being the longest. *E. Lamarckii*, Latr. (allied to *Aranea nobilis*, Fabr.), &c.

In the others, forming the greatest number, the general outline of the eyes forms a crescent, with the convex part in front. *A. globosa*, Fab.; *A. cristata*, Clerck; *A. atrea*, De Geer, &c.

Storena, Walck., although imperfectly known, appears to terminate this section, and to lead to *Oxyopes* (which is as much allied to the Crab-Spiders as to the Wolf-spiders), and has the maxillæ inclined upon the lip, which is long and triangular, and nearly as long as them; the chelicerae, conical; the two fore-legs and then the second pair the longest; the eyes arranged thus—2, 4, 2.

The second general division of the bipulmonary Spiders, that of the WANDERERS (*Vagabondes*,

* M. Walckenaer places this genus in the series of those which are at times wandering and sedentary, such as Attus, Thomisus, Drassus, &c., and which have only two hooks to the tarsi.

thus named in opposition to the former division of the *Sedentary* species), have the eyes, always eight in number, extended lengthways along the thorax rather than transversely, or at least the space they occupy is as long as broad, and which form, by their union, either a curvilinear triangle, or a truncated oval, or a square. Two or four of their eyes are often much larger than the others; the thorax is broad, and the feet are robust, those of the fourth pair, the two first, or those of the second pair generally, exceed the others in length. These Spiders do not spin webs, wait for their prey, seize it running or leap upon it. We divide these into two sections, the Citigrades and the Saltigrades.

The first, that of the *Citigrades*, comprises the species which are called Wolf-spiders by some writers. The eyes form, by their arrangement, either a curvilinear or oval triangle, or a square, the front side of which is much narrower than the breadth of the thorax; this part of the body is ovoid, narrowed in front, and with a central longitudinal ridge; the legs are only fitted for running; the maxillæ are always straight and rounded at the tip; the females of most of the species sit upon their cocoon or carry it about with them, applied against the breast and the base of the belly, or suspended at the anus. They do not abandon it except in the utmost extremity, and return to hunt for it when they have no longer cause of alarm. They also tend their young with care for a certain period of time.

Oxyopes, Latr., *Sphasus*, Walck., have the eyes arranged in four transverse lines, in pairs, the front and hind ones being shortest, so as to form a kind of oval. The first pair of legs is longest. *S. heteropthalmus*, Walck.; *O. variegatus*, Latr., &c.

Ctenus, Walck., has the eyes arranged in three transverse lines, gradually becoming broader (2, 4, 2,) and forming a kind of reversed curvilinear triangle, truncated at the front, or its narrowest part. The tongue is square; the fourth and then the first pair of legs are the longest. Established on a Spider, of large size, found at Cayenne.

Dolomedes, Latr., has the eyes arranged in three transverse lines (4, 2, 2), forming a square, rather broader than long, with the two posterior placed on an eminence; and which have the second pair of legs as long or longer than the first pair; those of the fourth pair are longest. The tongue is square.

Some species have the two lateral eyes of the front line longer than the two middle ones placed between them, and the abdomen terminated in a point. The females construct, on the top of trees full of leaves, a silken nest, like a funnel or bell, where they lay their eggs, but when they go out to hunt or are forced to abandon their retreat, they always carry their cocoon with them, attaching it to their breasts. Clerck says that he saw them leap upon flies which were flying around them. *Ar. mirabilis*, Clerck; *A. rufo-fasciata*, Fab. &c.

The other species have the four front eyes of equal size, and the abdomen oval and rounded at the tip. They inhabit the sides of water, running on its surface with surprising quickness, and even entering into it without being wetted. The females make, amongst the branches of vegetables, large irregular webs, in which they place their cocoon, which they guard until the young are hatched. *Dol. marginatus*, Walck.; *A. fimbriatus*, Clerck, &c.

Lycosa, Latr., which have the eyes arranged in a square, as long as or longer than it is broad, with the two posterior not placed upon an eminence. The first pair of legs is evidently longer than the second, but shorter than the fourth, which is the longest. The maxillæ are obliquely truncate; the tongue is square, but longer than broad.

All these Spiders usually live on the ground, where they run with great swiftness. They dwell in holes, which they have found or formed, lining its inside with silk, and increasing its size as they grow. Some take up their abode in holes of walls, where they make silken tubes, the outside of which they cover with earth or sand, and in which they moult and hybernate, having first closed the entrance. The females also therein lay their eggs; they carry their egg-case with them when they go out to hunt, and which is attached by threads to the anus. The young ones fasten themselves, as soon as they are hatched, upon the body of their parent, and there remain attached until they are sufficiently strong to seek their own food. They are very voracious, and defend the position of their habitation with great courage.

A species of this genus, the Tarentula, so named from the city of Tarentum, in Italy, in the environs of which it is common, is very celebrated. In the opinion of the vulgar its venom occasions dangerous wounds, often followed by death, or by the complaint termed tarentism, which could only be cured by the aid of music and dancing. Judicious people think it more requisite to combat the terrors of the imagination than the effects of the venom, for which the medicinal art supplies various remedies. M. Chabrier has published some observations upon the Tarentula of the South of France (*Soc. Acad. Lille*, 4 *Cahier*). The genus is numerous in species, which have not yet been clearly defined.

L. tarentula (*Aranea tarentula*, Linn.,) is about a foot long, with the under side of the abdomen red, with a transverse central black bar.* The Tarentula of the South of France (*L. narbonnaise*, Walck.) is rather smaller, with the belly black, with a red margin. *L. febrilis*, Clerck, an analogous species, occurs near Paris; *L. saccata* is much smaller, and is very common near Paris [and London].

Myrmecia, Latr., in *Ann. Sci. Nat.*, tom. iii. p. 27 [as the generic name implies, greatly resembles an Ant]. The legs are long, nearly filiform, the fourth and the first pairs being the longest; the thorax appears as if divided into three parts, the anterior of which is much larger than the other two, which are knotted. The abdomen is

* [Several species have been confounded under this name. M. Dufour has published an elaborate account of the habits of one of these, which he regards as the real *M. Tarentula*, in the *Annales des Sciences Naturelles*, 1835, translated in the *Magazine of Natural History*, vol. i., new series.]

much shorter than the thorax, and covered half way from the base by a solid epidermis. *M. fulva*, Brazil. There also appear to be other species in Georgia, in North America.

[*Myrmarachne*, MacLeay, appears only to be a geographical section of Myrmecia, having the head portion of the cephalothorax more elongated, whereby the posterior eyes are removed wider apart. *M. atra* of Perty, is precisely of the same form as *Myrmarachne melanocephala*. It is likely to lead to erroneous impressions to assert that these Spiders prove that the order may include species with additional articulations, as they are only constricted in several places, and not articulated.]

The second section of the Wandering Spiders, that of SALTIGRADES, has the eyes arranged in a large square, the front row extending the whole breadth of the thorax, which is nearly square, or semi-oval, flat, or but slightly gibbose above, as broad in front as in any other part, and suddenly deflexed at the sides. The legs are fitted for running and leaping; the fore-thighs are often greatly dilated.

One of these insects is very common in summer (*Aranea scenica*, Linn.) upon walls and windows exposed to the sun, takes short leaps, stopping suddenly after a few steps, and raising itself on its legs. When it discerns a fly, or especially a gnat, it approaches it cautiously till within leaping distance, when it darts upon it, not fearing to take a perpendicular leap, because it always at the same time suspends itself by a thread, which it winds off as it advances. It also serves to suspend it in the air, and to mount up again to the spot whence it leaped, or to sustain it whilst the wind carries it from place to place. Such are the general habits of this section. Many species construct, amongst the leaves, under stones, &c., silken nests, in the form of oval sacs, open at each end, into which they retire in order to take rest, to moult, and to take refuge against the inclemency of the weather. If menaced with danger they quit their retreats, and run off with great agility. Some species construct, with the same material, a kind of tent, which serves for the birth-place of their posterity, and in which the young reside for some time with their parent. Other species, resembling Ants, elevate their fore-legs and vibrate them with great rapidity. The males sometimes engage in contests, in which their manœuvres are very singular, but which do not terminate fatally.

Tessarops, Rafinesque, nearly approaches the next, but differs, if there be not some error, in the number of its eyes, which is only four. (See *Annal. Gen. Sci. Physiq.*, tom. viii.)

Palpimanus, Dufour (in ditto, tom. v.), appears also intermediate between Eresus and Salticus, the eyes being arranged as in the former; the tongue is also triangular and pointed, and the maxillæ are dilated and rounded at the tip, but they are inclined; the terminal joint of the anterior tarsi is inserted laterally, and wants the ungues. *P. gibbus*, Dufour, does not leap, but only creeps slowly. It is found under stones in Valencia. M. Lefebvre brought a new Spider from Sicily, which appears to belong to this genus.

In the two following genera there are always eight eyes, and the maxillæ are straight.

Eresus, Walck., has four of the eyes arranged in a small square in front of the thorax, and the other four forming a much larger square at its sides; the tongue is triangular, and the tarsi terminated by three ungues. *E. cinnaberinus*, Walck., *Aranea 4-guttata*, Rossi, &c.

Salticus, Latr., *Attus*, Walckenaer, has four of the eyes in a cross line in front of the thorax, the two middle ones being the largest, and the two others at the sides of the thorax, thus forming a large square open behind; the tongue is very obtuse at the tip, and the tarsi have only two terminal ungues. The males of many species are furnished with very large cheliceræ. Some species have the thorax thick, sloping, and very much inclined at the base. *Aranea sanguinolenta*, Linn., South of France, and many other species.

The others have the thorax flattened and roof-like at the base, the body being rather oval, and clothed with thick pubescence, with the legs robust, as in *Aranea scenica*, Linn., or narrow, elongated, subcylindrical, and naked, with the legs long and slender, as *Aranea formicaria*, De Geer.

[Since the second edition of this work many additional genera of Spiders have been published by Mr. Blackwall, in the *London and Edinburgh Philosophical Magazine*, from time to time, as well as by M. Walkenaer, in the work above referred to. The genera Cherses, Arkys, Erigona, and Plectanus, established by the latter, are extremely singular in their forms. The former of these authors has devoted much attention to the economy and structural peculiarities of many species of Spiders, his researches being published in the *Transactions of the Linnæan Society*. M. Hahn also commenced the publication of an elegant little work, *Die Arachniden*, since his death continued by M. Koch, in which a vast number of Spiders are described and figured. M. Perty also described and figured many Brazilian species in his *Delectus of the Articulated Animals of Brazil*. A great number of European species are also figured by Herrick Schäffer, in his continuation of Panzer's work upon German insects. M. Lucas, who is attached to the entomological department of the *Jardin des Plantes*, has made these insects his particular study, and has communicated some interesting species to *Guerin's Magasin de Zoologie* and the *Annales de la Société Entomologique de France*

THE SECOND FAMILY OF THE PULMONARY ARACHNIDA,—

THE PEDIPALPI,—

Possesses very large palpi in the shape of extended arms, terminated by a pincer or claw. The cheliceræ, or external pincers, have two fingers, one of which is moveable. The abdomen is composed of very distinct segments, without spinnerets at the tip; and the sexual organs are placed at the base of the belly. The entire body is clothed in a hard skin. The thorax is composed of a single piece, and exhibits, near each of its anterior angles, three or two eyelets, approximating or grouped together; and near the middle of its anterior extremity, or posteriorly, but in the medial line, two other eyelets, also close together. The number of pulmonary sacs is four or eight.

Some (which form the genus TARANTULA*, Fabr.) have the abdomen attached to the thorax by a peduncle, or by a portion of the transverse diameter, without comb-like plates at its base beneath, or a sting at its extremity. The spiracles, four in number, are situated near the base of the belly, and covered by a plate. The chelicerae (mandibles of authors) are clawed, or merely terminated by a moveable hook. The tongue is elongated, very narrow, and hidden. They have only a pair of maxillæ, formed of the basal part of the palpi. All of these have eight eyes, of which three, on each side, near the anterior angles, are arranged in a triangle; and two near the middle, upon the front margin, placed upon a common tubercle, or upon a small eminence, one on each side. The palpi are spinose. The tarsi of the two fore-legs differ from the others: they are composed of many joints, and resemble threads, without a terminal hook. These Arachnida inhabit only the hottest parts of Asia and America. We are unacquainted with their habits. They now constitute two genera.

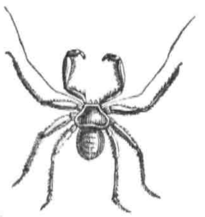
Fig. 31.—Phrynus reniformis, reduced.

Phrynus, Oliv., has the palpi terminated by a spined hook; the body very flat; the thorax large, nearly crescent-shaped; the abdomen destitute of a tail; and the two anterior tarsi exceedingly long and slender, resembling thread-shaped antennæ. *Phalangium reniforme*, Linn., Herbst. East Indies. *Tarantula reniformis*, Fabr. Antilles, &c.

Thelyphonus, Latr., is distinguished from Phrynus by the very short, thick palpi, terminated by a claw formed of two fingers. The body is long; thorax oval; and the tip of the abdomen is furnished with a long articulated seta, forming a tail. The two anterior tarsi are very short, with but few joints. *Phalangium caudatum*, Linn. Java. South America produces another species, described and figured in the *Journ. de Phys. et d'Hist. Nat.*, 1777, which the inhabitants of Martinique call the "Vinaigrier." A third smaller species inhabits the Gangetic Delta.

[M. Lucas has lately published a valuable monograph upon Thelyphonus, with figures, in Guérin's *Magasin de Zoologie*, containing six species, the largest of which (*T. giganteus*) is two inches and a half long, and inhabits Mexico.]

The other Pedipalpi have the abdomen intimately connected with the thorax, throughout its entire width, presenting, at the base beneath, two moveable comb-like plates, and terminated by a knotted tail, armed with a sting at its extremity. The spiracles are eight in number, exposed, and arranged four and four on each side, along the abdomen. The chelicerae are terminated by two fingers, the outer one being moveable. They form the genus

SCORPIO, Linn., Fabr.

These have the body long, and suddenly terminated by a long, slender tail, composed of six knots, the last of which terminates in a curved and very acute point or sting, beneath the extremity of which are two small orifices, by which a venomous fluid is discharged, contained in an internal reservoir. The thorax is oblong, and generally furnished with a longitudinal, central, compressed line, having on each side, near its anterior extremity, three or two ocelli, forming a curved line; and near the middle of the back are two other ocelli, approximated together. The palpi are very large, with a forceps-like claw at the tip: the basal joint forms a concave and rounded maxilla. At the base of the four fore-legs is a triangular appendage; and these pieces form, by their approximation, a kind of lip with four divisions, the two lateral ones being considered as maxillæ, and the two others as forming the tongue. The abdomen is composed of twelve joints, including the tail: the basal joint is divided into two parts, the anterior bearing the sexual organs, and the posterior the two combs, the number of the teeth of which varies according to the species, and even with the age of the individual, and of which the use has not yet been deter-

* [As there is great possibility of confounding this genus with the famed Tarentula, described above, amongst the Spiders, it would have been better to have rejected it entirely, as it is an evident misnomer.]

mined. Each of the four following segments has a pair of pulmonary sacs and spiracles. Immediately after the sixth segment, the abdomen is suddenly narrowed, the six terminal knotted joints forming the tail. The tarsi are alike, and 3-jointed, with two terminal ungues. The two nervous cords running from the brain are united at intervals, forming seven ganglions, of which the terminal ones belong to the tail. For further details of the anatomy of these animals, consult the works of Treviranus, M. de Serres, and Léon Dufour (*Journ. de Physique*, 1817).

These Arachnida inhabit the warm countries of both hemispheres, living in the ground, hiding themselves under stones or other bodies, generally amongst ruins, or other dark and cool places, and even in the interior of houses. They run quickly, and curve the tail over the back. They can turn it in all directions, and employ it as an arm of defence or offence. They seize Wood-lice, and other ground insects, such as Carabi, Weevils, Orthoptera, &c., which serve them as food, with their pincers, pricking them with their stings, and then carrying them to their mouth. They are also particularly fond of the eggs of Spiders and other insects.

The wound occasioned by the sting of the *Scorpio europæus* is not, as it appears, ordinarily dangerous. That of the Scorpion of Souvignargues, of Maupertuis, or of the species which I have named Occitanus, and which is more powerful than that of the preceding, produces, according to experiments which Dr. Maccary had the courage to try upon himself, more alarming effects. The poison appears to increase in power according to the age of the animal. Volatile alkali, either applied interiorly or exteriorly, is used to counteract its effects.

Some authors assert that the indigenous [French] species produce two broods in a year, but it appears more correct to consider that this takes place in the month of August. According to Maccary, it changes its skin before coupling. The female carries her young upon her back for several days, at first not quitting her abode at such time, and takes care of them for the space of a month, by which time they are able to shift for themselves.

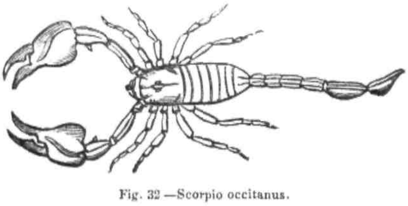

Fig. 32.—Scorpio occitanus.

Some have eight eyes, forming Leach's genus *Buthus*. *Scorpio afer*, Linn., which is five or six inches long, and inhabits the East Indies, Ceylon, &c. *S. occitanus*, Amoroux, (*Tunetanus*, Herbst.) Middle of Europe, Barbary, Spain, &c.

The others have only six eyes, forming the restricted genus *Scorpio* of Leach. *S. europæus*, Linn., Fab., Herbst. South of France.

[The genus *Scorpio*, Linn., has been revised by Hemprich and Ehrenberg in their great work upon the animals of Arabia, and many new genera and subgenera separated therefrom. Many new species have also been recently described by Koch, in the continuation of Hahn's *Die Arachniden*.]

THE SECOND ORDER OF ARACHNIDA,—

TRACHEARIÆ,—

Differs from the preceding in the respiratory organs, which consist of radiating or ramified tracheæ*, which only receive the air by two spiracles; in the absence of a circulating organ†, and in the number of the eyes‡, which is only two or four. From the want of sufficiently generalized anatomical observations, the limits of this order are not rigorously determined. Some species, indeed, of these Arachnida—such as the *Pycnogonidæ*—do not exhibit any spiracles; and their mode of respiration is unknown.

The trachean Arachnida are naturally divisible into those provided with cheliceræ terminated by two fingers, one of which is moveable, or by a single one, equally moveable, in the form of a hook, and those where these organs are replaced by simple plates or lancets, which, together with the tongue, compose a sucker; but the majority of these animals being minute, their examination is attended with very great difficulties, so that these characters ought only to be resorted to when it is impossible to adopt others.

* The tracheæ are vessels which receive and distribute the aerial fluid in every part of the interior of the body, and thus remedy the want of circulation. They are of two kinds,—tubular or elastic (formed of three membranes, the middle one composed of a spiral thread), and vesicular, formed of only two membranes these form a kind of pneumatic reservoir, capable of inflation, communicating with each other by means of tubular tracheæ. The tracheæ are divided into two principal trunks, extending along the sides of the body, and receiving the air by orifices or spiracles. There are also, in many insects, two other longitudinal trunks, situated between the preceding, with which they communicate, and which Serres calls pulmonary tracheæ, giving to the ordinary ones the name of arterial tracheæ. He also distinguishes the kind of spiracles: the common ones are closed by membranous lips, opening by simple contraction the others, named trémaères by Serres, are shut by corneous, moveable plates, and are peculiar to some Orthoptera. Some aquatic larvæ have a very peculiar respiratory apparatus.

† The presence of tracheæ excludes all complete circulation,—that is, the distribution of the blood to different parts, and its return from the organs of respiration to the heart. Hence, although certain vessels have been discovered in some insects (*Phasmæ*), and their existence is possible in the trachean Arachnida, these creatures do not the less enter into the general system. M. M. de Serres has observed that the intestinal canal of Phalangium emits a very great number of cœcums, or vermiform appendages, which appear analogous to hepatic vessels, and that the tracheæ ramify most extensively upon these cœcums.

‡ According to Müller, *Hydrachna umbrata* has six eyes; but is not this a mistake?

THE FIRST FAMILY OF THE TRACHEAN ARACHNIDA,—

THE PSEUDO-SCORPIONES,—

Has the thorax articulated, with the anterior segment largest, like a corselet; the abdomen very distinct, and annulated; the palpi very large, in the shape of feet or claws; eight legs in both sexes, with two equal-sized ungues at the tip of the tarsi,—the two anterior, at the most, excepted; two apparent cheliceræ, terminated by two fingers; and two maxillæ, formed of the basal joint of the palpi. All of these are terrestrial, and have the body oval or oblong. This family comprises only two genera.

Galeodes, Oliv. (*Solpuga*, Lichtenstein, Fabr.), having two very large cheliceræ, with vertical, strongly-toothed fingers, one superior, fixed, and often furnished with a slender, elongated, pointed appendage* at its base, and the other moveable; the palpi are large, projecting, and in the shape of feet or antennæ, terminated by a short, vesicular joint, without any terminal hook; the two fore-legs have a similar shape, and are equally unarmed, but smaller; the others are terminated by a tarsus, the last joint of which has two small cushions, and two long fingers, with a hook at their tips; five scales are attached by a peduncle upon each hind leg, disposed in a row upon the basal joints; two eyes are placed close together upon an eminence in front of the anterior thoracic segment, which represents a large head, supporting the mouth and two fore-legs.

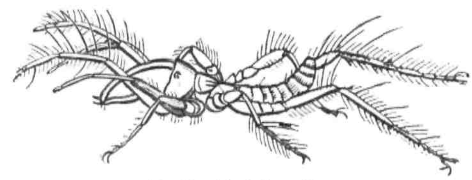

Fig. 33.—Galeodes intrepida.

The body is oblong, generally soft, and clothed with long bristles; the knob at the tip of the palpi incloses a peculiar organ, which is only protruded when the animal is irritated; the two fore-legs may be considered as a second pair of palpi. I have discovered a large spiracle on each side of the body, between the first and second legs, as well as a slit at the base of the belly. The abdomen is 9-jointed. For further details, see the description of a species found in Spain, by Dufour (*Annales Sci. Physiq.*, tom. v. pl. 69).

It is supposed that the ancients designated these Arachnida under the names of Phalangium, Solifuga, Tetragnatha, &c. M. Poë discovered a species near Havannah, but the others are peculiar to the warm and sandy countries of the old world. They run with very great quickness, erect their heads when surprised, showing signs of resistance, and are reputed venomous. *Solpuga fatalis*, Latr. Bengal. Others are described in the monograph of Herbstin, and the voyages of Olivier and Pallas.

[Other species are figured, with elaborate details, by Savigny, in the great work on Egypt; and M. Lucas has described and figured a species from Cuba (*G. Cubæ*), in Guérin's *Magasin de Zoologie*. Dr. Schomburgh has also forwarded, this year, to the Entomological Society of London, a species, of small size, from Demerara, which he found in the nest of a species of Termes.]

Chelifer, Geoff. (*Obisium*, Illiger), has the palpi elongated like arms, with a claw-like hand with two fingers; all the legs are equal, and terminated by two ungues; the eyes stand at the sides of the thorax. These animals resemble small Scorpions deprived of tails. The body is flattened, with the thorax nearly square, and having one or two eyes on each side. They run quickly, and often sideways, like Crabs. The eggs are united in a mass. The elder Hermann says that they carry them beneath the belly; and he also believes that these Arachnida are able to spin. The younger Hermann and Leach divide them into—

Chelifer proper, having the first segment of the thorax divided in two by a transverse impressed line; a style at the tip of the moveable finger of the cheliceræ; it has only two eyes.

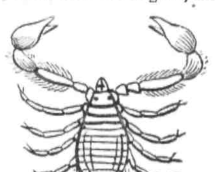

Fig. 34.—Chelifer fasciatus.

Phal. cancroides, Linn., commonly called the Book Scorpion, is found in herbariums, old books, &c., where it feeds upon the minute insects which frequent such situations. *Scorpio cimicoides*, Fabr. Lives under stones, the bark of trees, &c.

Obisium, Leach, has the thorax without division; the cheliceræ without a style. It has also four eyes.

See the monograph of *Scorpionidæ* of Leach (*Zool. Miscell.* vol. iii.), and Dalman's memoir on Copal Insects, where a species is described under the name of Eucarpus. [Some new species of this group are described and figured by M. Theis, in *Annales des Sci. Nat.*, Sept. 1832].

THE SECOND FAMILY OF THE TRACHEAN ARACHNIDA,—

THE PYCNOGONIDES,—

Has the thorax composed of four segments, occupying nearly the whole length of the body, terminated at each extremity by a tubular article, of which the anterior (which is larger, and either simple or pro-

* I do not believe this appendage is peculiar to one sex.

vided with cheliceræ and palpi, or one kind of these organs) constitutes the mouth.* Both sexes have eight feet, fitted for running; but the females exhibit, besides, two false legs, situated near the anterior pair, and only employed in carrying the eggs. These animals are marine, analogous either to Cyamus and Caprella†, or to the Arachnida of the genus Phalangium, with which Linnæus united them. The body is commonly linear, with very long legs, consisting of eight or nine joints, and terminated by two unequal ungues, appearing only to form a single one, the smaller one being slit. The anterior segment of the body, which replaces the head and mouth, forms a projecting tube, nearly cylindrical, or conical, having a triangular or trilobed orifice at its extremity. It is furnished, at the base, with the cheliceræ and palpi. The former are cylindrical and linear, simply prehensile, 2-jointed, the terminal joint cheliferous, with the lower finger, which is immoveable, sometimes very short. The palpi are filiform, from 5 to 9-jointed, with a hook at the tip. Each succeeding segment, with the exception of the last, supports a pair of legs; but the anterior of those with which the head is articulated, bears, on the back, a tubercle, on which is placed a pair of ocelli; and on the under side, in the females alone, two other slender legs, folded upon each other, and bearing the eggs, which are placed all round them in one or two masses. The last segment is small, cylindrical, and pierced by a small orifice at the tip. We can discover no vestiges of spiracles. M. Edwards, who has observed these animals in a living state, tells us that he has seen, in the interior of the feet, lateral expansions of the intestinal canal, or cœcums. I had also perceived the traces, under the form of blackish vessels, in different Nymphons; and hence I am induced to believe that these creatures respire by the skin,—a peculiarity which would render the establishment of a distinct order necessary, probably between the Arachnida and apterous parasitic insects. They are found amongst marine plants, under stones near the beach, and occasionally also on the Cetacea.

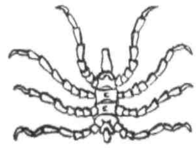

Fig. 35.—Pycnogonum balænarum.

Pycnogonum, Brunn., Müll., Fabr., is destitute of cheliceræ and palpi, and their legs scarcely exceed the length of the body, which is proportionately shorter and thicker than in the following genera. They live upon Whales.

Phoxichilus, Latr., has no palpi, but the legs are very long, and they have two cheliceræ. *Pycnogonum spinipes*, O. Fabr.,—*Ph. aculeatum* and *spinosum* of Montague, *Transactions of the Linnæan Society*,—*Nymphon femoratum* of the Acta of the Society of Natural History of Copenhagen, 1797, &c.

Nymphon, Fabr., resembles the last in the very narrow and oblong form of the body, the length of the legs, and presence of cheliceræ; but they have moreover two palpi, composed of five joints. *N. grossipes*, O. Fabr., Müller, *Zool. Dan.* Compare, also, Leach, *Zool. Miscell.* vol. iii. 19, f. 1, 2.

Ammothea, Leach (*A. carolinensis*, Leach), differs from Nymphon in the cheliceræ being much shorter than the mouth, the basal piece being very small. The palpi are 9-jointed.

[From the apparent absence of breathing pores, Latreille, in his *Cours d'Entomologie*, forms these animals into a distinct order,—Aporobranchia; but Leach had previously given to them the expressive name of Podosomata. There are several British species described by Dr. Johnston in the *Magazine of Zoology and Botany*, No. iv., wherein several new genera are proposed. It will, however, be necessary to change the names of some of them, as they are already employed for genera of Crustacea. A still more extraordinary genus, with ten legs, is described by Eights in the *Boston Journal of Natural History*, under the name of *Decalopoda australis*.]

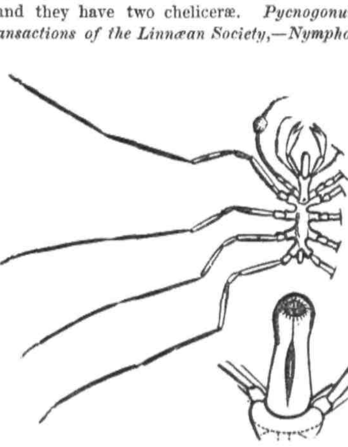

Fig. 36.—Nymphon grossipes, and under side of its beak.

THE THIRD FAMILY OF THE TRACHEAN ARACHNIDA,—

THE HOLETRA (Hermann),—

Has the thorax and abdomen united into a mass, beneath a common epidermis. The thorax is at most divided into two by a strangulation; and the abdomen merely presents, in some species, the traces of articulations, formed by foldings of the epidermis. The anterior extremity of the body is often ad-

* The siphon of a large Phoxichilus, brought from the Cape by Delalande, exhibits longitudinal sutures, so that it appears to me to consist of a labrum, tongue, and two maxillæ, all soldered together. The palpi are thence those of the maxillæ.

† According to Savigny, they form the passage between the Arachnida and Crustacea. I place them in this situation with doubt.

vanced, in the form of a muzzle or beak. The majority have eight legs, the others six.* This family is composed of two tribes.

The first tribe is that of the harvest-men, PHALANGITA, Latr., having the cheliceræ very apparent, either projecting in front of the trunk or being inferior, but always terminating in a didactyle forceps, preceded by one or two joints. They have two filiform palpi of five joints, the last terminated by a small hook; two distinct eyes; two maxillæ, formed by the prolongation of the basal joint of the palpi, and often four others, composed merely of the dilated coxæ of the two anterior pairs of feet. The body is oval or rounded, covered, at least upon the thorax, by a more solid skin. The abdomen exhibits the appearance of foldings. The legs are long, always eight in number, and divided distinctly, in the manner of those of insects. Many (*Phalangium*) have, at the base of the two posterior feet, two spiracles, one on each side, but hidden by the coxæ. The majority live on the ground, upon plants, or at the roots of trees, and they are very active; others hide themselves beneath stones, or in moss.

Fig. 37.—Phalangium cornutum.

Phalangium, Linn., has the cheliceræ projecting, much shorter than the body, and the eyes placed upon a common tubercle. The legs are very long and slender, and, when detached from the body, they exhibit signs of irritability for a few moments. *Ph. cornutum*, Linn., male; *Ph. opilio*, Linn., female; and other native species. Consult, also, the monographs of this genus published by Latreille at the end of his *Hist. Nat. des Fourmis;* Herbst. and Hermann, *Mém. Aptérolog.*

Gonyleptes, Kirby, has the palpi spined, with the two terminal joints nearly equal-sized; and the coxæ of the hind pair of legs are very large, and soldered together, forming a plate beneath the body. The hind legs are wide apart from the others. *G. horridus*, Kirby. Brazil.

Fig. 38.—Gonyleptes acanthurus.

Siro, Latr., has the cheliceræ projecting nearly as long as the body; the eyes wide apart, and each placed upon an isolated tubercle, or without support. *S. rubens*, Latr.

Macrocheles, Latr., has exposed and very long cheliceræ, but the eyes are either sessile or wanting. The two fore-legs are very long, and resemble antennæ. The upper side of the body is like a scale, without distinct articulations. *Acarus marginatus*, and *A. testudinarius*, Hermann.

Trogulus, Latr., has the anterior extremity of the body projecting like a clypeus, receiving, in a cavity on its under-side, the cheliceræ and other parts of the mouth. The body is very flat, and covered by a very firm skin. It is found beneath stones. *T. nepæformis*, Latr. *Phal. tricarinatum*, Linn. South of France.

[M. Dufour has described a genus allied to the last under the name of *Cæculus*, in the *Annales des Sci. Nat.* for 1832. Many other very curious Brazilian species are described and figured by Perty, in the *Delectus Animalium Brasiliæ*, in which many new genera are proposed for their reception. Another very singular species, with exceedingly long legs, is described by Mr. Hope, in the *Linnæan Transactions*, vol. xvii., under the name of *Dolichoscelis Haworthii*.]

The second tribe of the *Arachnida holetra* is that of the ACARIDES, which has occasionally cheliceræ, but they are simply composed of a single pincer, either didactyle or clawed, and hidden in a sternal lip. Sometimes there is a sucker, formed of lancet-like plates united together; or the mouth consists merely of a cavity, without any other apparent pieces. This tribe is composed of the genus

ACARUS (Linn.),—

The majority of the species of which are very minute, or almost microscopical. They are universally distributed. Some are wanderers; and, amongst these, some are found under stones, leaves, the bark of trees, in the ground, the water, or upon provisions, such as flour, dried meat, old dry cheese, and upon putrid animal matters. Others subsist as parasites upon the skin, and in the flesh of different animals, often greatly weakening them by their excessive multiplication. The origin of certain diseases, especially the itch, is attributed to them. It appears, from the experiments of Dr. Galet, that the Mites of the human psora, placed upon the body of a perfectly healthy individual, will inoculate him with the serus of that disorder. Other sorts of mites are also found upon insects; and many beetles, which subsist upon cadaverous substances or excrement, are often entirely covered with them. They have even been observed in the brain and eyes of Man. The Mites are oviparous, and exceedingly prolific. Many of them are born with only six feet, and the two others are developed a short time afterwards. The tarsi are

* *Trombidium longipes*, Herm., is figured with ten legs, the anterior being very long, but it is described as having only eight.

terminated in various ways, according to their habits. Some of these insects (*Acarides*, Latr.) have eight legs, fit only for walking, and cheliceræ.

Trombidium, Fabr., has the cheliceræ terminated by a moveable claw; palpi projecting, pointed at tip, with a moveable appendage or finger beneath the extremity; two eyes, each at the top of a small fixed peduncle. *T. holosericeum*, Fabr., very common in gardens during spring, of a blood-red colour, with the abdomen nearly square, and narrowed behind. A much larger species (*T. cinctorium*, Fabr.) inhabits the East Indies, and emits a red dye.

Erythræus, Latr., has the cheliceræ and palpi of Trombidium, but the eyes are sessile, and the body not divided. *E. phalangioides*, Latr.

Gamasus, Latr., has the cheliceræ didactyle, and the palpi projecting, distinct, and filiform. In some, the body is covered entirely, or in part, by a scaly skin, but in others it is entirely soft. Some of the latter species live upon different birds and quadrupeds. Others, as the *Acarus telarius*, Linn. [or the Red Spider of the hot-houses], form, upon the leaves of various vegetables, especially upon those of lime-trees, very fine webs, which injure them greatly. This species is reddish, with a black spot on each side of the abdomen.

Cheyletus, Latr., has didactyle cheliceræ; but the palpi are thick, arm-like, and terminated by a sickle-shaped joint. *A. eruditus*, Schr.

Oribata, Latr. (*Notaspis*, Herm.), has the cheliceræ also didactyle; the palpi very short, or concealed; the body covered with a hairy, scaly skin; feet long, or moderate. The front of the body is advanced like a beak. Found upon stones, trees, in moss, &c. They creep but slowly.

Uropoda, Latr., has, from analogy, forceps-like cheliceræ; palpi not projecting; body covered with a scaly skin; legs short; anus with a long thread, by which this insect is attached to various beetles, and suspended in the air. *A. vegetans*, De Geer.

Fig. 39.—Acarus domesticus, magnified.

Acarus, Fabr. (*Sarcoptes*, Latr.), has two didactyle cheliceræ; palpi very short, or concealed; body very soft; tarsi terminated by a vesicle. Some species feed upon our alimentary substances (*A. domesticus*, *A. farinæ*); others are found in the ulcers of the itch in man, the horse, cat, dog, &c. (*A. scabïei*. See the Thesis of Dr. Galet upon this species).

Other Mites or Ticks (RICINIÆ, Latr.) have also eight legs, formed for walking, but destitute of cheliceræ, which are replaced by lancets, forming, with the tongue, a sucker. Some have the eyes distinct.

Bdella, Latr., having the sucker advanced and beak-like, with long, elbowed palpi, and four eyes. *Scirus longirostris*, Herm.

Smaridia, Latr., with palpi short and straight, and two eyes. *A. sambuci*, Schr., &c.

The other Riciniæ have not the eyes perceptible; the palpi are in the shape of valves, dilated at the tip, serving as a sheath to the sucker, of which the parts are horny and toothed; the body is clothed with a corneous skin, or at least with a scaly plate in front. These ticks are parasites, sucking the blood of various vertebrated animals; and although at first very much flattened, they acquire, by suction, a very large size, and become swollen out like a bladder. They are round or oval.

Ixodes, Latr. (*Cynorhæstes*, Herm.), has the palpi casing the sucker, and forming, with it, a protecting beak, truncated, and slightly dilated at the tip. They are found in thick woods, abounding in brush-wood, briers, &c., attaching themselves to low plants by the two fore-legs, extending the other feet. They fasten upon dogs, cows, horses, and other quadrupeds, and even upon the tortoise, burying their suckers so completely in their flesh that they can hardly be detached by force, and by tearing away the portion of skin to which they are fastened. They deposit a prodigious number of eggs, discharging them from the mouth, according to M. Chabrier.* Their multiplication upon the ox and horse is sometimes so great that these animals perish from exhaustion. The tarsi are terminated by two ungues inserted upon a plate, or are united at the base upon a common peduncle. The ancients appear to have known these animals under the name of Ricini. They are our well-known Ticks,—*Ixodes ricinus*, Linn., attacking the Dog; and *Ix. reticulatus*, Latr., Fabr. (*Acarus reduvius*, Schr.), the Ox. The latter, when swollen, is half an inch long. The study of the species of this genus is not sufficiently advanced.

Fig. 40.—Ixodes plumbeus, and its beak, magnified.

Argas, Latr. (*Rhynchoprion*, Herm.), differs from Ixodes in the inferior situation of the mouth, and the palpi not encasing the sucker, and being 4-jointed instead of three. *A. reflexus*, Fabr., Latr. Upon pigeons. *A. persicus* (Malleh de Mianeh), described by travellers under the name of the Venomous Bug of Miana, has been the subject of a curious memoir by M. Fischer de Walldheim. [This insect formed the subject of much discussion at the Liverpool meeting of the British Association].

[M. Audouin has described and figured some species of the two preceding genera, and of those of Tetranychus and Pteroptus, in the *Annales des Sci. Nat.* for 1832.]

Other Mites (*Hydrachnellæ*, Latr.) have also eight legs, but they are ciliated, and fitted for swimming. They form the genus *Hydrachna* of Müller (*Atax*, Fabr.), and live only in the water. The body is oval

* [The anal orifice being minute, and close to the mouth, has been mistaken for the latter in this observation.]

or rounded, and generally soft: in some males, it is narrowed behind into a cylindrical tail. The number of eyes is either two or four, and even six, according to Müller.

Eylais, Latr., has the cheliceræ terminated by a moveable claw. *A. extendens*, Fabr.

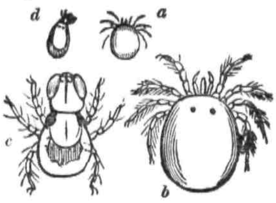

Fig. 41.—*a*, Hydrachna globulus; *b*, magnified; *c*, young larva; *d*, pupa.

Hydrachna, Latr., has the mouth composed of plates, forming a projecting sucker, and the palpi have a moveable appendage beneath the extremity. *A. geographicus*, Fabr., *A. globator*, Fabr.

Limnochares, Latr., has the mouth sucker-shaped, but the palpi are simple. *A. aquaticus*, Linn. [Other species of these water-mites have been described by M. Theis, in the *Annales des Sci. Nat.* for 1832].

[From the very valuable discoveries lately made by M. Dugès, it appears that these water-mites undergo metamorphoses, accompanied by a complete change of form, the larvæ having a very large head and six legs, whilst the pupæ are inactive, attaching themselves, by a single pair of legs, to the bodies of other aquatic insects, and consisting, as it were, simply of an oval bag with a narrow neck, the insect in this state having been formed, by M. V. Audouin, into the genus Achlysia, and specifically named *A. Dytici*, from taking up its residence beneath the elytra of the Water Beetle (*Dyticus marginalis*). They also attach themselves to the slender filaments composing the tails of the Water Scorpions (*Nepa* and *Ranatra*).]

Other Mites (*Micropthira*, Latr.) differ from all the foregoing, in having six legs. They are all parasites.

Caris, Latr., has the sucker and palpi distinct; the body rounded, very flat, and covered with a scaly skin. *C. vespertilionis*, Latr. On Bats.

[M. V. Andouin has figured an insect which he considers may be identical with *Caris vespertilionis*, in the *Annales des Sci. Nat.*, 1832; and which, notwithstanding its possessing only six legs, he considers as more properly belonging to the genus Argas.]

Leptus, Latr., has also a sucker and palpi, but the body is soft and ovoid. *A. autumnalis*, Shaw (*Misc. Zool.*, vol. ii. pl. 42), is very common, in autumn, upon grass and other herbage. They crawl upon our bodies, and insinuate themselves into the skin at the roots of the hairs, occasioning as painful an irritation as the itch. [It is the well-known Harvest Bug], but it is so minute as rarely to be observed.

The other species are found upon different insects, and enter into the division of the *Trombides hexapodes* of Hermann. *T. insectorum*, Herm., *T. Libellulæ*, Herm., *T. Culicis*, Herm., &c.

[*Aclysia*, Aud., here placed by Latreille, is now proved to be the immature state of Hydrachna.]

Atoma, Latr., has neither suckers nor palpi visible; the mouth consists only of a small orifice, situated upon the breast; the body is soft, oval, with the feet short. *Acarus parasiticus*, Herm.

Ocypete, Leach, belongs to this section, from the number of its legs; but, according to him, it has mandibles. *O. rubra*, Leach. Upon Tipulæ.

[From the recent observations of Audouin, Dugès, and others, it seems questionable whether this terminal section of the Mites can be retained, consisting, as it is now supposed to do, entirely of the young states of various groups of Acaridæ.]

[The Senator Van Heyden has lately published a distribution of the Acaridæ in the *Isis*; and many very minute species are figured in the continuation of Panzer's *Fauna Insectorum Germaniæ*, by Herrick Schäffer, distributed into many new genera. At the same time, M. Dugès, in his more elaborate and complete memoir, published in the *Annales des Sci. Nat.*, has revised the entire group, dividing it into numerous genera, arranged into the following groups:—1. Trombidiei; 2. Hydrachniei; 3. Gamasei; 4. Ixodei; 5. Acarei; 6. Bdellei; and, 7. Oribatei.]

THE THIRD CLASS OF ARTICULATED ANIMALS FURNISHED WITH ARTICULATED LEGS,—

INSECTS (INSECTA),—

Which have articulated legs, a dorsal vessel occupying the place of the vestige of a heart, but without any branch for circulation*; which respire by means of two principal

* Anatomists are divided in their opinion as to the nature of this organ, many regarding it as a distinct heart, whilst others (including Cuvier, whose opinion appears to have been fully confirmed by the researches of M. de Serres, inserted in the *Mémoires du Mus. d'Hist. Nat.*) deny it this quality. Some recent observations appear to establish the existence of several small vessels, but besides that, this circulation must be very partial, as Insects differ materially from the Crustacea, the blood not returning to the heart. According to Herold, as quoted by Strauss (*Bulletin. de Univers Ferussac*), the dorsal vessel is the true heart of insects, being, as in the higher animals, the locomotive organ of the blood, which, instead of being contained in vessels, extends through the general cavity of the body. This heart occupies the entire length of the bulk of the abdomen, and terminates anteriorly in a single artery, which is not ramified, and which carries the blood to the head, whence it returns to the abdomen by the mere effect of its accumulation in the head, to re-enter the heart; and it is in this that the entire circulation of the blood of insects consists, and which are consequently destitute of veins. According to M. f[illegible]

tracheæ, extending parallel to each other throughout the entire length of the body, having, at intervals, points from whence numerous branches extend, and which correspond with certain external orifices, or stigmata* [or, as they have been termed in a previous passage, spiracles], for the entry of the air. All of them have two antennæ, and the head distinct. The nervous system of the majority of insects (those with six feet) is generally composed of a brain, formed of two ganglions opposed to each other, united at their base, and emitting eight pairs of nerves and two single nerves, and of twelve ganglions†, all of which are in the inferior part of the body. The two anterior are situated near the union of the head and thorax; the second and two following are appropriated to the three segments of which the thorax is composed, and the remaining ganglions belong to the abdomen, each ganglion emitting nerves to the organs of their respective segments. The two nervous cords which form, by their reunion, the ganglions, are tubular, and composed of two tunics, the exterior of which exhibits tracheæ. A medullary substance fills the central canal. The fine work of M. Herold upon the anatomy of the caterpillar of the Great Garden White Butterfly, examined during its growth, and until the period of its transformation into the pupa, proves that the nervous system and the digestive organs undergo decided modifications, the nervous cords being at first longer and wider apart, which confirms the opinion of De Serres upon the origin and developement of the nervous system. We have already, in the general observations on the three classes of articulated-legged Articulata, stated the different sentiments of physiologists upon the seat of the senses of hearing and smell: we shall therefore merely add, that, in respect to the former, the small nervous ganglions situated upon the forehead, of which we have spoken, appear to confirm the opinion of those who, like Scarpa, place this sense near the base of the antennæ. In some Lepidoptera, I have detected two small apertures near the eyes, which may perhaps be the auditory channels. If, in many insects, especially those with filiform or setaceous and long antennæ, these organs are used as tactors, it appears difficult for us to account for their extraordinary developement in certain families, and more particularly in males, if we do not admit that they are actually the seat of the organ of smell. Probably, also, as regards the taste, the palpi, in those cases where they are very dilated at the tip, take

the heart, or the abdominal portion of this organ, is divided, internally, into eight chambers in the Cockchafer, separated from each other by two convergent valves, which permit the blood to be propelled forwards, but prevent its returning. The definition given by this naturalist of the dorsal vessel, whatever may be the interior composition of this organ, evidently proves that it is not a real heart: moreover, his observations do not determine the nature of this fluid, nor how it is directed into the other parts of the body, to effect their nutrition. [The still more recent observations of Carus, Bowerbank, and some others, have made us still better acquainted with the nature of this dorsal vessel, and its uses, confirming the views of Herold as to the existence of a decided circulation in insects, although it is of a nature very dissimilar to that of the higher animals].

* The number of the segments of the body of the Myriapoda being variable, that of their spiracles is so likewise, and extends sometimes to more than twenty. In hexapod insects, it is often eighteen,—nine on each side. This is, however, more the case with the larva than the perfect insect. Caterpillars, and most other larvæ, have a pair of spiracles in the segment which bears the first pair of feet. The second and third segments are deficient, because, as I presume, the developement of wings upon these segments renders the presence of spiracles unnecessary. Each of the fourth and seven following segments exhibits a pair; but in the perfect Beetles, in addition to the two anterior spiracles which are hidden in the cavity of the prothorax or corslet, and which have not been noticed, two others are to be perceived, situated between the base of the elytra and wings, being those of the mesothorax; but there are none to the metathorax, unless we consider those of the first abdominal segment as supplementary to the thorax, relying upon what takes place in the pedunculated Hymenoptera and Diptera, where these two segments, together with the demi-segment to which they belong, form part of the thorax. Thus, in genera., all hexapod insects have eight pairs of spiracles to the abdomen, the two last being often obsolete. In the Locusts and Dragon-flies, the sides of the mesothorax exhibit a pair of spiracles (*trémaères*, M. Serres). In these and some other insects with uncovered wings, the two first thoracic spiracles are placed above, between the pro- and meso-thorax. Except in Libellula, the true thorax does not exhibit any other spiracles. I say the true thorax, because, in some, the two anterior abdominal spiracles are transferred to the thorax. The metathorax of the Pentatomæ and Scutelleræ exhibits, on its under side, a pair of spiracles. In the wingless spectre insects [Phasmidæ], the mesothorax has none, but the metathorax has two pairs.

[We thus see that Latreille was perfectly aware that each of the three thoracic segments was occasionally provided with spiracles; and yet his theory, which has been noticed above (that the hind part of the thorax of the petiolated Hymenoptera and Diptera is abdominal), is founded upon the supposition that the metathorax cannot, of itself, possess spiracles, and that consequently the spiracles which we see on the hind part of the thorax of those insects, must be those of the anterior abdominal segment, transferred to the thorax. The common Earwig, as I have shown in a memoir upon the anatomy of that insect, published in the *Transactions of the Entomological Society*, exhibits an instance in which the pro-, meso-, and metathorax, are respectively furnished with a pair of spiracles. I have also entered fully into this question in the Hymenopterous portion of my introduction to the modern classification of insects, with a view to prove the general uniformity of the structure of the Hymenoptera with sessile and petiolated abdomens.]

† Some lamellicorn Beetles, in the perfect state, are exceptions.

the chief part. The tongue, also, cannot be a stranger to this function. The preparatory apparatus of the mouth; the intestinal canal; the biliary or hepatic vessels, and those which are called salivary, but which are less general; those free and floating vessels which have received the name of excremental; the epiploon, or fatty matter; and probably also the dorsal vessel,—such are the considerations embraced by the digestive system. It is singularly modified, according to the diversity of the food, whence arise a great number of particular types, of which we shall give the description in treating upon the different families. We will only say a few words upon the organs of the mouth [*instrumenta cibaria*, or *trophi*, as they have been collectively termed], and the principal divisions of the intestinal canal, commencing with the latter. In those in which it is most complex, such as the carnivorous Beetles, there may be distinguished the pharynx, œsophagus, crop, gizzard, stomach or chylific ventricle, and intestines, which may be divided into the slender intestines, the cœcum, and the rectum. In those insects which have the tongue applied upon the anterior or internal surface of the lip, or not disengaged, the pharynx is situated upon this surface: this is its general situation. It is questioned by M. Gaede whether the so-called biliary vessels are in fact secretors, as commonly considered; but the more recent observations of L. Dufour [published in a valuable series of memoirs in the *Annales des Sci. Nat.*] seem to disprove the opinion of M. Gaede.

Some insects (few in number, and destitute of wings, such as the Myriapoda, or Centipedes) are allied to many of the Crustacea, either in the number of their segments and legs, or in certain points of analogy in the structure of the parts of the mouth; but all the rest have only six legs, and the body, of which the number of segments never exceeds twelve, is always divided into three principal divisions,—the head, trunk [or thorax], and abdomen. Among the latter individuals, some are destitute of wings, preserving, throughout their whole life, the form which they had at their birth, increasing in size only by changing their skins, and which I have named Homotènes, "alike to the end," or the Ametabolia of Leach. They have, in this respect, certain relations with the animals of the preceding classes.

The other insects with six legs are almost universally winged; but the last-named organs, and often also the legs, do not appear at first, and are only developed at the close of a series of changes more or less singular, termed metamorphoses, and which we will shortly explain in a following page. The head* bears the antennæ, eyes, and mouth. The composition and form of the antennæ vary much more than in the Crustacea, and these organs are often much more developed and longer in the males than in the females.

The eyes are composite or simple. The former, according to the researches of Cuvier, Marcel de Serres, and others, are formed, 1st, of a cornea divided into a multitude of small [hexagonal] parts, and which is more convex according to the carnivorous propensities of the insect, its inner face being spread over with an opaque, scarcely fluid, various-coloured (although generally black, or of a dark violet colour) substance; 2nd, of a choroid, attached, by its contour and edges, to the cornea, covered with a black varnish, exhibiting a great number of aerial vessels, proceeding from large trunks of the tracheæ situated in the head, and of which the branches form around the eye a cir-

* Its surface is divided into numerous small regions named clypeus (*chaperon*, *nasus*, Kirby), face, forehead, crown, and cheeks. The denomination of "chaperon" being equivocal, I have changed it to epistoma: it supports the labrum, or upper lip. [M. Strauss, and some other recent anatomists, consider the head as formed of a series of segments soldered together, the mandibles, maxillæ, &c., representing the limbs attached to each. See also a memoir on the head of insects, by Mr. Newman.]

cular trachea: this, however, as well as the choroid, is wanting in various darkling insects; 3rd, of nerves, which arise from a large trunk proceeding immediately from the brain, which there dilates in a reversed conical form, the broad base being towards the cornea, and of which the threads, running through the choroid and inner plaster of the cornea, terminate separately in each of the facets. There is no crystalline nor vitreous tumour.

Many insects have, in addition to these composite eyes, simple eyes [*ocelli*], the cornea of which is smooth. They are generally three in number, and arranged in a triangle upon the crown of the head. In the majority of apterous insects, and the larvæ of those which gain wings, the ocelli replace the eyes, and are often inserted in a group: judging from the eyes of the Arachnida, they are evidently fitted for vision.

The mouth of Hexapod insects is in general composed of six principal pieces, their form being lateral, arranged in pairs, and mostly transversely; and two others, opposed to each other in a direction contrary to that of the preceding, filling up the space between the former: one is situated above the upper pair, and the other below the lower pair. In the masticating insects, or those which feed upon solid materials, the four lateral pieces perform the office of jaws (*mâchoires*), and the two others are considered as lips; but, as we have already observed, the two upper jaws have been distinguished by the particular name of mandibles, whilst the two others have alone retained the name of maxillæ (*mâchoires*): the latter are also provided with one or two articulated filaments which are called *palpi*,—a character which is never possessed, in this class, by the mandibles. The extremity of the maxillæ is often terminated by two divisions, or lobes, of which the outer, in the Orthoptera, is termed the *galea*. We have already said that the upper lip is called the *labrum*. The other lip, or the *labium* (*lèvre*, properly so called), is formed of two parts: the one, solid and inferior, is the *mentum;* the upper, which often bears two palpi, is the tonguelet (*languette*), [or *ligula*].*

In the suctorial insects, or those which derive their food from fluid aliments, these different organs of manducation appear under two general modifications. In the first, the mandibles and maxillæ are replaced by small, setaceous, lancet-like plates, forming, by their union, a kind of sucker, which is received in a sheath which takes the place of the labium, and is either cylindrical or conical, and articulated, in the form of a beak (*rostrum*), or membranous and fleshy, inarticulated, and terminated by two lips (*proboscis*). The labrum is triangular and arched, covering the base of the sucker.

In the second of these modifications, the labrum and mandibles are nearly obsolete, or extremely small. The labium is no longer a detached piece, and is only distinguished by the presence of a pair of palpi, of which it is the support. The maxillæ have acquired a very great length, and are transformed into two tubular threads, which, uniting by the edges, forms a kind of proboscis which is rolled up in a spiral manner, and is named the tongue, but which, to avoid misconception, it would be preferable to term the *spirignatha:* its interior presents three canals, of which the middle one forms

* According to what I have said in the introductory observations upon the Articulata in general, I consider the lower lip to be but a modification of the second maxillæ of the decapod Crustacea, combined with their tongue (languette). The gradual changes which take place in the form of these organs, in the Crustacea, Arachnida, and Myriapoda, naturally lead to this supposition. In this hypothesis, the six thoracic legs must be analogous to the foot-jaws of the Crabs; and as has been shown, in the crustaceous genus Apus. Moreover, the five anterior abdominal segments of hexapod insects will represent the segments which bear the true legs in the decapod Crustacea, or the third and four succeeding segments of the amphipod and isopod Crustacea. The various works published in respect to the thorax of insects will necessarily require revision when this part of the body is compared throughout the three annulose classes, its nomenclature being far from fixed in this respect.

the canal of the nutritive fluids. At the base of each of these filaments there is a palpus ordinarily very minute, and scarcely visible.

The Myriapoda are the only species of which the mouth exhibits another type of construction, which I shall describe when treating upon those insects.

The trunk* of insects, or that intermediate portion which bears the feet, is generally designated by the Latin name *thorax*, which the French term corselet. It is formed of three segments, which were not at the first carefully distinguished, and of which the relative proportions greatly vary. Sometimes, as in the Coleoptera, the anterior is by far the largest, separated from the following by an articulation, moveable, and alone exposed; which alone appears, at first sight, to compose the trunk, and bears the name of the thorax, or *corselet*. Sometimes, as in the Hymenoptera, Lepidoptera, &c., it is much shorter than the following, and constitutes, with the two others, a common body, attached to the abdomen by a peduncle, or closely united to it throughout its entire posterior breadth, and which is called the *thorax*.

These distinctions, thus established, were insufficient, and often ambiguous, as they did not rest upon a ternary structure of the thorax, as I had clearly noticed in the first edition of this work, as a character proper to hexapod insects. Mr. Kirby has employed the name of *metathorax* for the hind part of the thorax.† Those of *prothorax* and *mesothorax* naturally presented themselves to the mind when the ternary division of the thorax was once adopted, and the celebrated Professor Nitzsch was the first who used them. Some naturalists have since named the prothorax, or anterior thoracic segment which bears the anterior pair of legs, collar (*collare*). Wishing to preserve the name corselet, but to restrain its application in proper limits, we shall employ it in all those cases where this segment greatly surpasses the others in size, and where the latter are united to the abdomen so as to appear to constitute an integral part of it,—a peculiarity proper to the Coleoptera, Orthoptera, and many Hemiptera. When the prothorax is short, and forms, with the succeeding segments, a common and exposed mass, the trunk, composed of the three segments together, will retain the denomination of thorax. We shall also continue to call the inferior surface of the trunk the breast (*poitrine*), dividing it, according to the segments, into the fore-breast [*antipectus*], middle breast [*medipectus*], and hind breast [*postpectus*]. The middle line is the sternum, which we also divide into three:—The fore sternum [*prosternum*], middle sternum [*mesosternum*], and hind sternum [*metasternum*].

The teguments of the thoracic segments, as also those of the abdomen, are generally divided into rings or semi-rings: one dorsal, or superior, the other inferior, and united laterally by means of a soft and flexible membrane, which is indeed but a less solid portion of the same teguments in many insects, especially the Coleoptera. We also observe, at the reunion of these rings, a small space, more solid, or of the substance of

* To avoid all confusion, it would be better to restrict the term trunk to those Aptera of Linnæus which have more than six legs, and where these limbs are borne upon distinct segments, with the head *distinct from the trunk. In the Crustacea, where these two parts of* the body are soldered together, the thorax might take the name of thoracida, and in the Arachnida, cephalothorax, being here still more simple, with fewer appendages, that of thorax being reserved for the hexapod insects.

† This segment ought not to be restricted, in the Hymenoptera, to the upper, very short, transverse division of the thorax, at the sides of which the second pair of wings are inserted, being further composed of that portion of the thorax which extends to the base of the abdomen, as is proved by the position of the two last spiracles of the trunk. I even think this observation is applicable to all winged insects, the metathorax being divided, on the upper side, into two parts, one bearing, in the four-winged species, the second wings, and being destitute of spiracles, and the other being furnished with the latter. This *second part appears to be dependent upon the abdomen, as in nearly all* insects, except the petiolated Hymenoptera, Rhipiptera, and Diptera. Sometimes it is incorporated with the thorax, and closes it posteriorly, as in these last insects: hence I have named this second division of the metathorax, the medial segment. Thus, all the segments would have a pair of spiracles, but those of the mesothorax, scarcely distinct, or obsolete, in the Hymenoptera and Diptera, and the two metathoracic, situated upon the segment which immediately follows that which bears the second wings. The abdomen will thus be composed of nine segments, of which the last three compose the organs of generation.

the teguments themselves, each of which bears a breathing pore, so that the sides of the abdomen exhibit a longitudinal series of small pieces, or each segment is, as it were, divided into four. Other pieces, also corneous, occupy the lower sides of the mesothorax and metathorax, immediately beneath the insertion of the elytra and wings, which are supported by another piece, placed longitudinally. The relations of these parts, the size and form of the first joint of the coxæ, or haunches, the manner in which they articulate with the semi-ring to which they are attached, and the extent and direction of this variable semi-ring, furnish the thorax, considered in this respect, with a combination of characters which is very serviceable in a systematic point of view. Some naturalists, especially Knoch, had already made use of them, but without any determined principle, and with arbitrary names. It was, however, necessary to study the composition of the thorax carefully, in all the classes of insects—a task commenced by the late Lachat, and followed up by M. Victor Audouin, who presented a memoir on this subject to the Académie des Sciences. It is, however, only known to us by the general sketch of it given by Cuvier in his Report*, and by the extract published by its author in the article INSECT in the *Dictionnaire Classique d'Hist. Nat.* To adopt this nomenclature, and give it a general application, we must wait for this memoir and its illustrative figures; but in practice, the denominations already introduced will suffice. Another memoir, upon the same subject, by M. Chabrier, with admirable figures, and one by the elder Jurine upon the wings of the Hymenoptera, must also be mentioned.

As insects inhabit all kinds of situations, they have all the kinds of locomotive organs: namely, wings and legs, which last, in many species, are used as oars. The wings are membranous, dry, elastic, generally transparent, pieces attached to the sides of the back of the thorax; the anterior pair, when there are four, or when they are the only pair, being upon the mesothorax, and the posterior pair upon the following segment, or metathorax. They are composed of two membranes applied upon each other, and traversed, in various directions, by more or less numerous nervures, which are so many trachean tubes, forming sometimes a network, and sometimes simply veined. The elder Jurine has advantageously employed the disposition and crossing of these nervures in systematic arrangement. The Dragon-flies, Bees, Wasps, Butterflies, &c., have four wings; but those of Butterflies are covered with small scales, which at first sight resemble dust, and which give these insects the colours with which they are ornamented. They easily come off on being touched by the finger, and the portion of the wing from which they have been taken is transparent. With the microscope, these scales appear of varied figures, and are implanted upon the wing by means of a footstalk, and arranged regularly in rows like the tiles of a roof. In front of the fore-wings of these insects are a pair of pterygoda (a kind of epaulettes), which extend backwards along a part of the back, upon which they are applied. In certain insects, the wings remain

* [A long note is here given in the second edition, containing the details of M. Audouin's researches. I can, however, only introduce the following slight abridgment:—The trunk, or thorax, is always typically divisible, on the outside, into three segments, each bearing a pair of feet,—namely, the prothorax, mesothorax (bearing the fore wings), and metathorax (bearing the hind wings). Each segment is composed of four parts: one inferior, two lateral (these three forming the breast), and one dorsal, forming the back. The inferior part is the sternum; the lateral pieces, or flanks, are each divisible into three principal pieces; one (the episternum) attached to the sternum, another (the epimeron), articulating with the coxa. Another small piece (the trochantine) assists in the union of the epimeron and coxa, whilst the third piece of the flank is placed, in the meso- and metathorax, beneath the wing, and is called the hypoptera, since changed by Audouin to paraptera. The dorsal part, or tergum, is divided into four pieces, named, from their position in each segment, the præscutum, scutum, scutellum, and postscutellum: the first of which is often, and the last nearly always, internal. Thus the thorax is divisible into thirty-three principal pieces, or forty-three, including the hypoptera. The epimera had been previously called scapulæ, and parapleuræ, by Knoch. The posterior coxa of the Coleoptera, forming a transverse plate, is his mærium. Mr. M'Leay has subsequently published an elaborate memoir upon the structure of the thorax in the *Zoological Journal*.]

straight, or are folded up transversely; in others they are doubled up, or folded longitudinally, like a fan; sometimes they are horizontal, sometimes inclined like a roof; in many they meet upon the back, and in others they are wide apart.* The two-winged insects, of the dipterous order, have also, beneath their wings, two small moveable threads, terminated by a mass, and which, according to the ordinary opinion, replace the pair of wings which are deficient; they are called balancers† (*halteres*). Other two-winged, very extraordinary insects, have also two balancers, but situated at the anterior extremity of the thorax, and which we name, to distinguish them from the others, prebalancers (*prehalteres*). Above the true balancers is a small membranous scale, formed of two pieces, united at one of the edges, and resembling the two shells of a bivalve mollusc: this is the alulet, or cueilleron [*alula*]. Some aquatic Beetles also exhibit it beneath the elytra, inserted at their base.

Many insects, such as the Cockchafers, Cantharides, &c., have, instead of the two upper or anterior wings, two scale-like pieces, more or less thickened, and more or less solid and opaque, which open and shut, and beneath which the wings are transversely folded in repose. These scale-like pieces have received the name of *elytra*.‡ The insects which are furnished with these organs are called Coleoptera, or insects in a sheath. These pieces are never wanting§, but this is not always the case with respect to the wings themselves. In other kinds of insects, the extremity of these scales is entirely membranous, like the wings; and in this case these pieces are called hemelytra: [hence the name of the Linnæan order Hemiptera].

The *scutellum*, or escutcheon, is ordinarily a triangular piece, situated upon the back of the mesothorax, between the places of insertion of the elytra, or wings. It is sometimes very large, and then covers the greater portion of the upper side of the abdomen. Various Hymenoptera exhibit behind it, upon the metathorax, a small space called the false escutcheon (*post-scutellum*).

The legs are composed of a haunch of two joints [*coxa* and *trochanter*], a thigh [*femur*], a shank of a single joint [*tibia*], and a finger, commonly called the *tarsus*, which is divided into several phalanges, or joints, the number of which varies from three to five, depending chiefly upon the changes which the first and penultimate joints suffer in their relative proportions. Although the counting of these joints may sometimes prove difficult [from their minuteness], and the numerical series may not always be in relation with the natural system, it nevertheless forms a good character for the distinction of genera: the last joint is generally terminated by two hooks. The form of the tarsi is subject to some modifications, according with the habits of the insects. Those of the aquatic species are generally flattened, very much fringed, and resemble oars.‖

The abdomen, which forms the third and last part of the body, is confounded with

* That is, when the insect is in inaction. The rapidity of the vibrations of the wings appears to us to be one of the chief causes of the humming noise which many make. The explanations which have been given of it are not satisfactory. [Burmeister, and some others, have considered, more recently, that it is by the action of the air passing rapidly through the metathoracic spiracles, during flight, that this noise is produced].

† These are appendages, in my opinion, of the tracheæ of the first abdominal segment, and correspond to the space pierced with a small hole adjacent to the anterior edge of an orifice, with a membranous, internal diaphragm on each side of the same segment in the Locusts. (See my memoir on the articulated appendages of insects in the *Mém. du Mus. d'Hist. Nat.*) [On the supposition that the terminal part of the thorax of the Diptera is in fact thoracic, and not abdominal, as insisted upon by Latreille, these balancers will necessarily become metathoracic, and, as such, must be considered analogous to the posterior pair of wings. The large size of the true wings, and of the mesothorax, is in favour of this view of the subject, the alula, as it seems to me, being nothing but a portion of the fore-wing.]

‡ See M. Odier's memoir on the chemical composition of these organs, inserted in the *Mém. Societé d'Hist. Nat. de Paris* [translated in the *Zoological Journal*].

§ [Latreille has evidently overlooked the female of the Glow-worm, that of *Drilus flavescens*, and of *Pachypus excavatus*, all of which have neither elytra nor wings, although belonging to the order Coleoptera.]

‖ Mr. Kirby, in his monograph of the Bees of England, and in his excellent *Introduction to Entomology*, calls the tarsi of the fore-legs the hand, the first joint being the palm.

the thorax in the Myriapoda; but it is distinct in all the other insects which are furnished with six legs. It incloses the viscera, the sexual organs, and exhibits nine or ten segments, but of which some are often concealed, or very considerably reduced in size. The organs of generation are situated at its posterior extremity, except in the Dragon-flies and Iuli. The terminal segments of the abdomen compose, in many females, an oviduct (*oviscapt*, Marcel de Serres), which is either retractile or always exserted, and more or less complicated, and which is employed as a borer or augur. It is replaced by a sting in the females [and neuters] of many Hymenoptera.

After coupling, which ordinarily takes place but once, the female deposits her eggs in the places best suited for their preservation, so that when the young are hatched they find themselves in the midst of suitable food. The female also frequently collects provisions for them. These maternal cares often excite our surprise, and most clearly exhibit to us the instinct of insects. In the very numerous societies of many of these creatures—such as the Ants, White Ants, Wasps, Bees, &c.—the individuals composing the majority of the assembly, and which, by their labours and vigilance, support these societies, have been considered as neuter individuals, or without sex: they have been consequently named workers, or mules. It is, however, now ascertained that they are females, of which the sexual organs, or ovaries, are not fully developed, but which may become fruitful if a modification of their food, at a certain period of their early existence, takes place, whereby these organs are developed.

The eggs are sometimes hatched in the abdomen of the mother, which is then termed viviparous. The number of generations in a year, of a species, depends on the duration of each: more commonly, there is but one or two in the year. A species, under similar circumstances, is the more common in proportion as its generations succeed each other in rapidity, and the female is more fruitful.

A female Butterfly, after coupling, deposits her eggs, from which are hatched, not Butterflies, but animals with a very long body, divided into rings, a head provided with jaws, and several little eyes, having very short legs, of which six are scaly and pointed, placed in the front of the body, and the others, variable in number, membranous, and attached to the hind rings. These animals, called Caterpillars, live a certain time in this state, and change the skin several times. At length, however, a period arrives, when, from this skin of the Caterpillar, issues a very different being, of an oblong form, without distinct limbs, and which soon ceases to move, and remains a long time apparently dead, and dried up, under the name of a Chrysalis. On regarding it, however, mere closely, we perceive, in relief, upon the outer surface of this Chrysalis, the lines which represent all the parts of the Butterfly, but in proportions different from those which these parts will, at a future day, acquire. After a longer or shorter period, the skin of the Chrysalis bursts; the Butterfly comes forth, moist, soft, with flaccid and short wings, but in a few instants it dries, its wings grow, become stronger, and it becomes fitted for flight. It has six long legs, antennæ, a spiral proboscis, composite eyes: in a word, it does not in the least resemble the Caterpillar from which it had sprung, for it is ascertained that the changes in its state are nothing else than successive developements of the parts contained within each other. Such are the metamorphoses of insects. The first state is named the *larva*, the second the nymph [*pupa*], and the third the perfect state [*imago*]. It is only in the last-mentioned state that the insect is fitted for propagation.

All insects do not pass through these three states. Those which have no wings come forth from the egg with the forms they are always to maintain,—the Flea, female Mutillæ, Worker Ants, and a few others, excepted. These are called insects without a metamorphosis. Among those which have wings, a great number undergo no other change than that of acquiring them. These are said to undergo a demi-metamorphosis, their larva resembling the perfect insect, with the exception of the wings, which are entirely wanting. The pupa differs only from the larva in having rudiments of wings, which are developed at the last moulting, which brings the insect to the perfect state. Such are the Cimices, Grasshoppers, &c. Finally, the other insects provided with wings are said to undergo a complete metamorphosis, appearing, at first, under the form of a caterpillar or worm, and subsequently becoming an inactive nymph, but which exhibits all the parts of the perfect insect contracted, and, as it were, enveloped in a bandage.

These parts are free, although very closely approximated and applied against the body, in the pupæ of the Coleoptera, Neuroptera, Hymenoptera, &c.; but this is not the case in those of the Lepidoptera, and many of the Diptera. An elastic or still more solid skin is moulded over the body, and its exterior parts form for it a kind of case. The skin of the chrysalides of Lepidoptera, consisting only of a simple pellicle applied upon the external organs, following all their directions, and forming for each of them so many moulds, like the envelope of a mummy, permits them to be recognized and distinguished [*pupa obtecta*, Linn.]; but that of the two-winged flies, being formed or the dried skin of the larva, has merely the appearance of a cocoon in the shape of an egg. It is a kind of capsule, or case, in which the animal is inclosed (*pupa coarctata*, Linn.)

Many larvæ, previous to passing to the pupa state, construct for themselves, with silk which they draw from the interior of their own bodies, by means of the spinnerets of their lower lip, or with other materials which they have collected, a cocoon, in which they are inclosed. The perfect insect comes forth from the pupa by a slit or fissure which it makes down the back of the thorax. In the pupa of two-winged flies, one of its extremities is detached, in the form of a cap, for the passage of the insect.

The larvæ and pupæ of the insects with a semi-metamorphosis, differ only from the perfect state of the same insects in respect to their wings. The other outer organs are identical. But in complete metamorphosis, the form of the body of the larva does not always bear a constant relation with that which these insects have in their final state. It is generally more elongated; the head is often very different, both in its consistence and figure, and has only the rudiments of antennæ, or else wants them absolutely, and never exhibits composite eyes. The organs of the mouth are also very different, as may be at once perceived by comparing the mouth of a Caterpillar with that of a Butterfly, or the mouth of the larva of a Fly with that of the same insect perfectly developed. Many of these larvæ have no feet; others, such as those of Caterpillars, have many; but these, with the exception of the six anterior, are entirely membranous, without hooks at the tip. Some insects, such as the Ephemeræ, exhibit a singular exception in the metamorphosis: arrived at their perfect state, they again cast off another skin from their wings.

The insects which compose our first three orders, preserve, throughout life, the form which they have when born. The Myriapoda, however, exhibit the rudiments of metamorphosis, having at first only six feet, or being even, according to Savigny, entirely

destitute of them. The other feet, as well as the segments to which they are attached, are developed as the insect increases in age.

There are but few vegetable substances which do not fall under the attacks of insects; and as those which are useful or necessary to man are not less liable to them than the others, they often cause great damage, especially in seasons favourable for their multiplication. Their destruction depends greatly on our knowledge of their habits, and on our own vigilance. Some are omnivorous, such as the White Ants, Ants, &c., of which the ravages are too well known. Many among these are carnivorous; and the species which feed upon carcases or excrement are a benefit conferred on us by the Author of Nature, and compensate, in some respect, for the losses and inconveniences which the others cause to us. Some species are employed in medicine and in the arts, as well as our domestic economy. They have also many enemies: fishes destroy a great quantity of aquatic species; many birds, bats, lizards, &c., rid us of many of those which live upon the ground or in the air. The majority strive to avoid the dangers which menace their existence, by flying or running away; but there are some which employ for this purpose particular stratagems or natural arms.

Arrived at their last transformation, and enjoying all their faculties, they hasten to propagate their race; and when this is performed, their existence soon terminates. Thus, in our climate, each season of the year (winter excepted) presents to us many species which is peculiar to it. It nevertheless appears that the females, and neuters of those which live in society, have a longer existence. Many individuals bred in the autumn, conceal themselves during the rigours of winter, and reappear in the following spring.

Like vegetables, the species of insects are subject to geographical limits. Those, for example, of the New World (with the exception of a small number of the northern species), are essentially peculiar to it: it also possesses many genera equally peculiar. The Old World, on the other hand, possesses others unknown in America. The insects of the south of Europe, North Africa, and the west and south of Asia, have great general resemblance. It is the same with those of the Moluccas, and the more eastern islands, including those of the South Sea. Many species of the north are found in the mountainous regions of more southern climates. Those of Africa differ greatly from those of the opposite countries of America. The insects of Southern Asia, commencing from the Indus or Sind, and going to the east as far as the confines of China, have features greatly resembling each other. The intertropical regions covered with immense damp forests, are the richest in insects; and, in this respect, Brazil and Guiana are the most highly favoured.

All the general systematic arrangements, relative to insects, may be essentially reduced to three. Swammerdam took the metamorphosis as the base of his system; that of Linnæus is founded upon the presence or absence of wings, their number, consistence, superposition, nature of their surfaces, and upon the presence or absence of a sting; whilst Fabricius only employed the parts of the mouth. The Crustacea and Arachnida, in all these distributions, are considered as insects; and they are the terminal ones in that of Linnæus, which has been generally adopted. Brisson, however, had separated the Crustacea as a distinct class, which he had placed before that of the Insects, and which comprehended all those species which have more than six feet,—namely, the Crustacea and Arachnida of Lamarck, or the Insecta Apiropoda of Savigny.

Although this order was more natural than that of Linnæus, it has not been followed; and it is only recently that anatomical observations, and a more rigorous exactitude of the applications thence derived, have led us to the natural system.*

I divide this class into twelve orders, of which the first three, composed of species destitute of wings, do not essentially change their forms and habits, and are merely subject either to simple moulting or to a rudimental metamorphosis, whereby the number of feet and of the segments of the body are increased. These correspond with the Arachnides antennistes of Lamarck. The organs of sight, in these animals, ordinarily consist of an assemblage of simple eyes, of greater or less extent. The following orders compose the class of Insects of the same naturalist. From its natural relations, the order *Suctoria*, which only consists of the genus *Pulex* [or Flea], appears to terminate the class; but as I place at its head the insects which have no wings, this order, keeping up the regularity of the system, ought to succeed immediately after that of the Parasita.

Some of the English naturalists have established, from the consideration of the wings, several new orders; but I do not see the necessity for their admission, with the exception of that of the *Strepsiptera*, of which the denomination (*twisted wings*) appears to me to be defective, such not being the case, and which I consequently term *Rhipiptera*, or *fan-shaped wings*.†

The first order, MYRIAPODA, has more than six legs (twenty-four, and beyond), arranged along the whole length of the body, upon a series of rings, each of which bears one or two pairs, and of which the first, and also the second in many species, appears to form part of the mouth. They are apterous,—that is, deprived of wings and scutellum.

The second order, THYSANURA, has six feet, and the abdomen furnished, at the sides, with moveable pieces, in the form of false legs, or terminated by appendages fitted for leaping.

The third order, PARASITA, has six legs; is destitute of wings; exhibits no organs of sight, except ocelli; the mouth is for the most part interior, and only consists of a muzzle inclosing a retractile sucker, or of a slit situated between two lips, with two hooked mandibles.

The fourth order, SUCTORIA, has six legs; is destitute of wings; and the mouth is composed of a sucker, inclosed in a cylindrical sheath of two articulated pieces. They undergo metamorphosis, and acquire thereby locomotive organs which they did not at first possess. This character is common to the following orders; but, in them, wings are always developed by metamorphosis.

The fifth order, COLEOPTERA, has six legs; four wings, the superior pair having the form of sheaths; mandibles and maxillæ for mastication; the lower wings folded simply crosswise, and the sheaths crustaceous, and always horizontal. They undergo a complete metamorphosis.

The sixth order, ORTHOPTERA, has six legs; four wings, of which the two upper are in the form of sheaths; mandibles and maxillæ for mastication, the latter covered at

* Cuvier, *Tabl. Elem. de l'Hist. Nat. des Anim.*, and *Leçons d'Anat. Comparée*; Lamarck, *Système des Anim. sans Vertèbres*; Latreille, *Précis des Caract. Gen.*, and *Genera Crustaceorum et Insectorum*. See also, for further details, the excellent *Introduction to Entomology* by Messrs. Kirby and Spence. [The *Horæ Entomologicæ* of M'Leay, the *Handbuch der Entomologie* by Hermann Burmeister, translated Shuckard, and my *Introduction to the Modern Classification of Insects*, may also be alluded to, as offering many details relative to the natural arrangement of this class].

† [It is true that the wings are not twisted, but the *prébalanciers*, as Latreille terms them, are; and, as it is now proved that these organs are mesothoracic organs, the propriety of Mr. Kirby's name is established.]

the extremity with a galea; the lower wings folded in two directions, or simply longitudinally, and the sheaths ordinarily coriaceous, mostly crossing at the inner margin. They only undergo the semi-metamorphosis.*

The seventh order, HEMIPTERA, has six feet; four wings, the two upper having the form of coriaceous sheaths, membranous at the extremity, or similar to the inferior pair, but larger and stronger; the mandibles and maxillæ are replaced by setæ, forming a sucker, inclosed in a sheath of a single, articulated, cylindrical, or conical beak-like piece.

The eighth order, NEUROPTERA, has six feet; four membranous, naked wings; and mandibles and maxillæ for mastication. The wings are finely reticulated, the lower pair generally of the size of the anterior, or more extended in one of their diameters.

The ninth order, HYMENOPTERA, has six feet; four membranous, naked wings; mandibles and maxillæ for mastication; the lower wings smaller than the superior; the abdomen of the females nearly always terminated by a borer, or sting.

The tenth order, LEPIDOPTERA, has six feet; four membranous wings, covered with little coloured scales, like dust; a horny piece, like an epaulette, directed backwards, inserted in front of each of the fore-wings; the maxillæ replaced by two tubular filaments united, and composing a kind of tongue rolled up in a spire.†

The eleventh order, RHIPIPTERA, has six feet; two membranous wings, folded like a fan; two crustaceous, moveable bodies, in the form of small elytra, situated at the fore extremity of the thorax‡; and the organs of manducation consist of a pair of simple, setiform maxillæ, with two palpi.

The twelfth order, DIPTERA, has six feet; two membranous wings, extended, and accompanied, in nearly all, by two moveable bodies, in the form of balancers, situated behind them; and the organs of manducation consist of a sucker, containing a variable number of setæ, inclosed in an inarticulated sheath, often under the form of a proboscis, terminated by two lips.§

THE FIRST ORDER OF INSECTS,—

MYRIAPODA (MITOSATA, Fab.),—

Commonly called Centipedes or Millepedes, are the only animals of this class which have more than six feet in the perfect state, and in which the abdomen is not distinct from the trunk (or thorax). Their body, destitute of wings, is composed of a generally extensive series of segments, nearly of equal size, each generally bearing, with the exception of the anterior segments,

* De Geer first established this order, which he called Dermaptera, changed, without propriety, by Olivier, into Orthoptera. I retain the latter, because the French naturalists have generally adopted it. [Dr. Leach, to add to the confusion, employed the name Dermaptera for an order consisting of the family of the Earwigs. The name ought certainly to be restored to the mandibulated Hemiptera of Linnæus].

† The thorax of the Lepidoptera has more analogy with that of the Neuroptera than with the Hymenoptera, the medial segment appearing to form part of the abdomen, whilst in the latter and the Diptera, it is incorporated with the thorax.

‡ Formed, as I presume, of pieces analogous to the pterygoda of the Lepidoptera. [Such is not the case, as is proved by the dissections of the thorax published by Curtis and myself, being rudimental elytra, similar to those of *Sitaris*, *Atractocerus*, and certain Phasmæ].

§ [It would be cut of place to enter into a review of the various systems proposed by different celebrated authors, as Fabricius, Leach, Kirby, M'Leay, Laporte, and others; but as the school of English Entomologists adopt various orders not employed by Latreille, it will not be improper to observe, that the orders Myriapoda, Thysanura, and Parasita, are generally, by most English authors, excluded from the class of Insects, forming a distinct class—Ametabola. The family of the Earwigs is raised to the rank of an order by Kirby and Leach, under the name of Dermaptera, which, to prevent further confusion, I have changed to Euplexoptera. The genus Thrips has been formed into an order by Mr. Haliday, named Thysanoptera; Phryganea, or the Caddice-flies, compose the order Trichoptera of Kirby; the suctorial Hemiptera, with the fore-wings entirely of a membranous consistence, are separated as the order Homoptera of Latreille; whilst the Forest-flies (*Hippoboscæ*, Linn.) form the order Homaloptera of Leach, separated from the Diptera.]

two pairs of legs, mostly terminated by a single hook, whether these segments may be undivided or separated into two semi-segments, each having a pair of these organs, and of which one alone presents two spiracles.*

The Myriapoda resemble, for the most part, small Serpents or Nereides, having the legs closely placed together throughout the whole length of the body. The form of these organs is also extended to the parts of the mouth. The mandibles are biarticulate, and immediately succeeded by a piece in form of a lip, divided into four parts, with the divisions articulated, or similar to small feet, and which, from its situation, corresponds with the tongue (*languette*) of the Crustacea: then follow two pairs of small feet, of which the second pair is in the form of large hooks in many, appearing to replace the four maxillæ of the latter animals, or rather the two maxillæ and lower lip of the Insects, being a kind of mouth-feet. The antennæ, two in number, are short, and rather thickened to the tip, or nearly filiform, 7-jointed in some, much more numerously jointed in others, and setaceous. The eyes are generally formed of an union of minute ocelli; and if in some species they exhibit a facetted cornea, these facets are proportionably larger, rounder, and more distinct than in the eyes of Insects. The spiracles are often very small, and their number, in consequence of that of the segments, is often greater than in the latter, where it never exceeds eighteen or twenty. The number of these segments and that of the legs, increases with their age, a character which distinguishes the Myriapoda from the Insects, the latter being always born with the number of segments which is proper to them, and with all their true unguiculated feet developed at the same period, or at the time of their quitting the pupa state. M. Savi, jun., Professor of Mineralogy at Pisa, has particularly studied the Iuli, and observed that they are destitute, on quitting the egg, of these organs, so that these animals undergo a real metamorphosis. The situation of the sexual organs, compared with the Crustacea and Arachnida, seems to point out the separation of the thorax and abdomen.

The Myriapoda live and grow longer than the other insects, and, according to M. Savi, at least two years are required by some (Iuli), before the organs of generation appear.

From these particulars we may conclude that these animals approach the Crustacea and Arachnida, on one side, and the Insects on the other; but, from the consideration of the presence, form, and division of the tracheæ, they belong to the latter class.

[The relations of this tribe of animals are very difficult. Whilst Latreille and Kirby regard them as entering the class of Insects, other authors have considered them as forming part of the Arachnida; and M'Leay has separated them from both these classes, and formed them into two orders, *Chilopoda* and *Chilognatha*, raising them, together with the two other orders, *Thysanura* and *Anoplura* (or *Parasita*, Latr.), and certain annulated Vermes, into a distinct class, to which he applied the name of *Ametabola* (changeless), which Leach had proposed only for the spring-tailed insects and lice.]

We divide them into two families, quite distinct, both in their organization and habits, and formed by Linnæus into two generic groups.

THE FIRST FAMILY OF THE MYRIAPODA,—

CHILOGNATHA, Latr. (or the genus *Iulus* of Linn.),—

Has the body generally crustaceous, and often cylindrical, the antennæ rather thickened at the tips, or nearly of equal thickness, and consisting of seven joints, two thick mandibles without palpi, very distinctly divided into two portions by a central articulation, with the teeth imbricated and planted in a cavity at its upper extremity; a kind of lip (*languette*, or lower lip, composed, according to Savigny, of the two pairs of maxillæ of the Crustacea) situated immediately beneath and covering them, being of a crustaceous texture, flat, and divided at the outer surface, by longitudinal sections and notches, into

* The rings of the body of insects have generally two spiracles. If the segments of a large Scolopendra are examined (one of those with twenty-one pairs of feet), it will be seen that they are alternately provided with, or deprived of, the two spiracles, and thus comparatively they are only to be considered as demisegments. Hence each complete segment has two pair of feet, one pair being supernumerary, each segment in the other insects having only a pair of feet.

four principal divisions, tubercled at its superior edge, the two middle divisions being narrower and shorter, and situated at the upper extremity of another piece, serving as a common base; the legs are very short, and always terminated by a single claw; four legs situated immediately beneath the preceding piece of the form of the following, but placed nearer together at the base, with the basal joint proportionately longer, and the majority of the remainder attached, in double pairs, to each of the succeeding joints. The male organs are placed behind the seventh pair of legs, and those of the female behind the second pair. The spiracles are placed alternately above the base of the feet, and of a very small size.

The Chilognatha crawl very slowly, or, as we may rather say, glide along, rolling themselves into a spire or ball. The first segment of the body, and in some also the second, is largest, and represents a corselet, or small shield. It is only at the fourth, fifth, or sixth segment in different species, that the duplication of the legs commences; the two or four first legs are entirely free to the base, or they do not adhere to their respective segments but by a middle or sternal line. The two or three terminal segments are destitute of feet. We observe on each side of the body a series of pores, which had been regarded as spiracles, but which, according to M. Savi, are merely orifices for the discharge of an acid fluid of a disagreeable odour, which appears to serve for the defence of these animals; the respiratory apertures, discovered by him, are placed upon this sternal piece of each segment, and communicate interiorly with a double series of pneumatic pouches, disposed in a chain throughout the whole length of the body, whence extend trachean branches which are extended upon the other organs. According to M. Strauss, these vesicular tracheæ are not connected together by a principal trachea, as is customary.

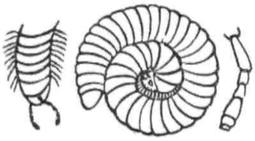
Fig. 42.—Iulus, with the body coiled up, and the front of the body unrolled, with the antennæ magnified.

The form of individuals just hatched is like a kidney, perfectly smooth and without appendages; eighteen days afterwards they undergo a first moult, when they assume the adult shape, but they have only twenty-two segments, and the total number of their legs is twenty-six pairs. M. Savi appears to contradict the assertion of De Geer, that the young have only three pairs of legs and eight rings in the young individuals; but is it certain that the moulting of which Savi speaks is really the first?—or ought we not, on the contrary, to conclude that these young do not suddenly pass from a state exhibiting no locomotive organs to one with so many as twenty-six pairs, or in other words, that there are intermediate changes, which have escaped the notice of M. Savi? Do not the observations of the Swedish Reaumur confirm these intermediate changes? Be this as it may, the eighteen outer legs alone serve for locomotion. At the second moulting the animal exhibits thirty-six pairs, and at the third moult forty-three; at this time the body consists of thirty segments. In the adult state the male has thirty-nine, and the female sixty-four; two years afterwards they again moult, at which period the generative organs first appear. From their birth, which takes place in March, until November, when Savi ceased his observations, these changes of the skin took place nearly monthly. In the exuviæ, even the membrane which lines the interior of the elementary canal and tracheæ is to be perceived, the organs of the mouth being the only parts which M. Savi could not discover. (*Osservazioni per servire alla storia di una specie di Iulus communissima*, Bologna, 1817; and another memoir upon *Iulus fœtidissima*, published in 1819, noticed in the *Bulletin of Ferussac*, December, 1823).

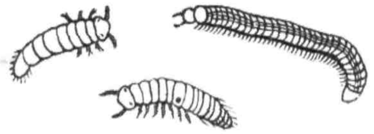
Fig. 43.—Transformations of Iulus, from De Geer.

These insects feed upon decaying animal and vegetable matter, and they deposit a great number of eggs under ground. According to Linnæus they form the single genus

Iulus, Linn.,—

which we divide as follows:—

Some have the body crustaceous, without appendages at the tip, and the antennæ thickened towards the extremity.

[Fam. 1.—Glomeridæ, Westw., or the *Launiformes* of Latreille, in the *Cours d'Entomologie*.]

Glomeris, Latr., resembles Wood-lice, being of an oval form, and rolling themselves into a ball; the body convex above, concave beneath, with a row of small scales along each side of the body beneath, analogous to each of the lateral divisions of the Trilobites. They are only composed of twelve segments, exclusive of the

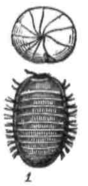

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Fig. 44.—Glomeris marginata.

head. These animals are terrestrial, and live under stones in hilly places. *Iulus ovalis*, Linn.; *Glomeris marginata*, Leach.

[Fam. 2.—IULIDÆ, Westw., or the *Anguiformes* of Latr., *Cours.*]

Iulus proper, Linn., has the body cylindric and very long; they roll themselves up spirally, without any prominent edge or rim at the sides of the segments. The larger species live on the ground, particularly in sandy places and woods, and emit a disagreeable scent. The smaller ones feed upon fruits and the leaves and roots of esculent vegetables; others are found under the bark of trees, in moss, &c. *I. maximus*, Linn., a native of South America, reaches seven inches in length. *Iulus sabulosus*, Linn. (*fasciatus*, De Geer), about sixteen lines long, blackish-brown, with two reddish lines down the back; body with fifty-four segments, the penultimate pointed,—Europe; and other species described by Savi and Leach (*Zool. Misc.*)

Polydesmus, Latr., resembles Iulus in its linear form and habit of rolling itself in a coil, but the segments are compressed at the sides beneath, with a produced margin. Found under stones in damp places. *I. complanatus*, Fabr., and others.

The species with distinct eyes form Leach's genus *Craspedosoma*, and appear to be proper to England, not having been noticed by any prior author.

[Fam. 3.—POLLYXENIDÆ, Westw., or the *Penicillata* of Latr., *Cours.*]—*Pollyxenus*, Latr.—Has the body membranous, very soft, and terminated by pencils of small scales. The antennæ are of equal thickness throughout. *Scol. lagura*, Lin., very minute: it has twelve pairs of legs, placed on the same number of semisegments. Found in crevices of walls and under old bark.

[Dr. Leach has given an excellent monograph of the British species of this family or order, in the third volume of the *Zoological Miscellany*, illustrated by figures. M. Brandt has more recently given a distribution of the tribe, in the *Bulletin Soc. Imper. Naturalistes de Moscou*, tom vi., 1833, dividing them into three sections,—A, *Pentazonia* (*a*, Glomeridea, genus Glomeris, 11 species; *b*, Sphærotheria, gen. Sphærotherium, 5 species; and Sphæropiæus, 2 species); B, *Trizonia*, (*a*, Julidea, gen. Iulus, 13 species; and Spirobolus, 2 species; *b*, Spirostreptidea (gen. Spirostreptus, 2 species; Spiropæus, 1 species; Spirocyclistus, 1 species); 3, *Monozonia* (gen. Strongylosoma, 1 species; Craspedosoma, 2 species; Polydesmus, 6 species; also, probably, *Pollyxenus*, Latr., and *Callipus*, Risso). Gray, in Griffith's translation of the *Règne Animal*; Perty, in the *Delectus Animal. Articul. Brasiliæ*, and Guérin, in the *Iconographie* of the *Règne Animal*, have added various other species or genera. Rafinesque also described numerous other genera, which have been entirely neglected by systematists.]

THE SECOND FAMILY OF THE MYRIAPODA,—

CHILOPODA, Latr. (or the genus *Scolopendra*, Lin.),—

Which has the antennæ more slender towards the extremity, of at least fourteen joints or more, a mouth composed of two mandibles furnished with a small palpiform appendage, exhibiting, in the middle, the appearance of a soldered articulation, and terminated like a spoon, with toothed edges; a quadrifid lip*, of which the two lateral divisions are the largest, annulated transversely, resembling the membranous feet of Caterpillars; two palpi, or small feet, united together at the base, and hooked at the tip; and a second lip†, formed by a second pair of legs, dilated and united at the base, and terminated by a strong hook, moveable, and pierced beneath the extremity with a canal for the discharge of a venomous liquid.

The body is depressed and membranous; each of its rings is covered with a coriaceous or cartilaginous plate, and only bears, in general, a single pair of feet‡, the last of which is directed backwards, and prolonged like a tail. The organs of respiration are composed entirely, or in part, of tubular tracheæ.

These animals run quickly; they are carnivorous, shun the light, and hide themselves beneath stones, logs of wood, the bark of trees, in the earth, &c. The inhabitants of hot climates dread them greatly, the species inhabiting those regions being very large, and their poison much more powerful. *Scolopendra morsitans* is called, in the Antilles, the Malfaisante. Some of them exhibit a luminous property.

The spiracles are more like those of Insects than those of the preceding family, and are either lateral or dorsal.

This family (in the arrangement of Dr. Leach composing the order Syngnatha) may, from the last-mentioned characters, and the nature of its respiratory and locomotive organs, be thus divided. Some

* Analogous to the lower lip of the Chilognatha, and representing, in my opinion, the tongue of the Crustacea, but able to perform also the office of maxillæ. Savigny names it the first auxiliary lip.

† Second auxiliary lip of Savigny. It is not articulated with the head, but with the anterior extremity of the first semisegment. It may also represent the lower lip of masticating insects. From these and numerous other relations furnished by the Entomostraca and Arachnida, I consider that the legs of the hexapod Insects are analogous to the six foot-jaws of the decapod Crustacea.

‡ In this case they are only semisegments.

have only fifteen* pairs of feet; and their body, when seen from above, exhibits fewer segments than when seen from beneath.

Scutigera, Lamarck (*Cermatia*, Illiger), forming a genus very distinct from the rest of this family, has the body covered by eight shield-like plates, beneath each of which M. de Serres has observed two pneumatic sacs, or vesicular tracheæ, communicating with tubular, lateral, and inferior tracheæ. The under side of the body is divided into fifteen semi-segments, each bearing a pair of legs terminated by a very long, slender, and multiarticulated tarsus: the hind pairs are very long. The eyes are large and facetted. They form the passage from the preceding family to the present. They are very active, and often lose some of their legs when touched. The French species (*Scolopendre à vingt-huit pattes*, Geoff.,—*S. coleoptrata*, Panzer?) hides itself under the beams and joists of the wood-work of houses. *S. longicornis*, Fabr., and other species.

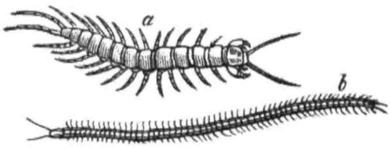

Fig. 45.—*a*, Lithobius forcipatus, *b*, Geophilus longicornis.

Lithobius, Leach, has the spiracles lateral; the body divided, both above and below, into the same number of segments, each of which bears a pair of legs; and the dorsal plates are alternately longer and shorter. *Scolopendra forcipata*, Linn., and others described by Fabricius, Panzer, and Leach (*Zool. Miscel.* vol. iii.)

The others have at least twenty-one pairs of feet, and the segments are of equal size and number, both above and beneath.

Scolopendra proper, Linn. Those species which have only twenty-one pairs of feet, after the two hooks forming the lower lip and the antennæ, and have seventeen joints, form Leach's genera *Scolopendra* and *Cryptops*. In the former, comprising the largest species, the eyes are distinct, eight in number, four on each side. In the latter, the eyes are wanting, or very slightly perceivable. The southern departments of France, and other countries of the south of Europe, produce a species (*Scol. cingulata*, Latr.) which is occasionally nearly as large as the common species of the Antilles, but having the body flatter. Also, *Scol. morsitans*, Linn.; *Scol. gigantæa*, Linn.; and others described by De Geer, Leach, &c., but incompletely.

Cryptops has the joints of the antennæ more globose, subconic, and the two hind legs more slender. Two species, found near London—*C. hortensis* and *Savignii*, Leach.

Geophilus, Leach, has more than forty-two legs, often much more numerous; antennæ 14-jointed, not so slender at the tip; body proportionately longer and narrower; eyes scarcely distinct. Some species are electrical (*Scol. electrica*, Linn.); and others, especially described by Leach in *Zool. Miscell.* vol. iii., *Scol. phosphorea*, Linn., fell from the clouds upon a vessel at the distance of one hundred miles from the main land.

Fig. 46.—Scolopendra.

[Dr. Leach published a valuable memoir upon these animals, illustrated by figures, in the third volume of the *Zoological Miscellany*. M. Brullé, also, in the French national work upon the Morea, and Koch, in Schaffer's continuation to Panzer, have published various detached species. Say described many American species; and M. Gervais has also published several memoirs on this tribe in the *Magasin de Zoologie*, the *Annals of the French Entomological Society*, and especially in the *Annales des Sciences Naturelles* for January, 1837, in which he has given a complete revision of the order, and has made some observations on the young state of some of these animals, and the changes they undergo.]

[In the *Bulletin of the Imperial Academy of St. Petersburg*, tom. i., No. 23, p. 182, Brandt has established another order amongst the Myriapodous Insects, dividing them into two orders:—1. Gnathogenæ, including all the previously known Myriapoda, with the two groups, Chilopoda and Chilognatha; and, 2. The Siphonozantia, which have the parts of the mouth produced into a proboscis. This new order is divided into two sections and three genera: namely, *Polyzonium*, Brandt; type, *P. germanicum*, found in Germany; and *Siphonatus* and *Siphonophora*, founded upon Brazilian species.]

THE SECOND ORDER OF INSECTS,—

THYSANOURA,—

Comprises those apterous insects furnished with six legs, which do not undergo a metamorphosis, and have, moreover, at the sides of the body, or its extremity, peculiar organs of locomotion.

* Leach counts two more pairs, because he includes also the palpi, and hooked feet of the head, in the number.

THE FIRST FAMILY OF THE THYSANOURA,—

LEPISMENÆ, Latr.,

Has the antennæ like threads, and divided, from the base, into a great number of minute joints; palpi very distinct and exposed; the abdomen furnished on each side, beneath, with a row of moveable appendages, like false legs, and terminated by articulated setæ, of which three are more remarkable; and the body is clothed with minute, shining scales. It composes the single genus

LEPISMA, Linn.,—

Which has the body elongated, and covered with small scales, silvery and shining, whence the most common species has been compared to a small fish. The antennæ are setaceous, and often very long. The mouth is composed of a labrum, two nearly membranous mandibles, two maxillæ, with two divisions, having a 5 or 6-jointed palpus, and a labium with four divisions, bearing two 4-jointed palpi. The thorax is composed of three segments. The abdomen, which is gradually narrowed towards its posterior extremity, has, at the sides, a row of small appendages arising from a short joint, and terminated in setose points: the posterior are the longest. A kind of scaly style, compressed, and formed of two pieces, arises from the anus; then follow three articulated setæ, which extend beyond the body. The legs are short, with the coxæ often very large, and strongly compressed and scale-like.

Many species hide themselves in the crevices of sashes which remain closed, or are but rarely opened, under damp boards, in wardrobes, &c. Others lie hidden under stones.

Fig. 47.—Machilis polypoda.

Machilis, Latr. (*Petrobius*, Leach), has the eyes very much facetted, nearly contiguous, and occupying nearly all the head; the body convex, arched above; the abdomen terminated by small threads fitted for leaping, the middle one placed above the other two, being much longer than them. They leap very well, and frequent stony places. The species are entirely European. *Lepisma polypoda*, Linn., &c.; *Petrobius maritimus*, Leach.

Lepisma, Linn. (*Forbicina*, Geoff.), has the eyes very small, wide apart, composed of a small number of grains; the body flat, and terminated by three threads of equal length, inserted in the same line, and not fitted for leaping; the coxæ very large. The majority of the species are found in the interior of houses. *Lep. saccharina*, Linn., four lines long, of a leaden, silvery colour, without spots, said to be a native of America, and other species.

THE SECOND FAMILY OF THE THYSANOURA,—

PODURELLÆ, Latr.,—

Have the antennæ composed of four joints; the mouth not exhibiting distinct and exserted palpi, and of which the abdomen is terminated by a furcate tail, applied, in inaction, against the belly, and used in leaping. These, also, only form the single genus

PODURA, Linn.

These insects are very small, soft, elongated, with the head oval, and two eyes, each formed of eight minute tubercles. The legs have only four distinct joints. The tail is soft, flexible, and composed of a basal piece, moveable at its insertion, and terminated by two branches forming the prongs of the fork, which are capable of opening and shutting. They can unfold their tail, striking it with force against the plane of position, and thus raising themselves into the air, and leaping like the Fleas, but to a more moderate height.

Some species are found upon trees and plants, or beneath bark or stones, and sometimes upon the snow itself, at the time of a thaw. Many species unite into numerous societies, upon the earth, in sandy paths, and resemble, at a distance, a small quantity of gunpowder. The propagation of some species appears to take place in the winter.

Podura, Linn., has the antennæ of equal thickness throughout, without minute joints at the tip; the body is linear or cylindrical, with the thorax distinctly articulated, and the abdomen narrow and oblong. *Podura arborea*, Linn.; *P. aquatica*, Linn., &c.

Smynthurus, Latr., has the antennæ slenderer at the tip, and terminated by an annulated joint; the thorax and abdomen form a globular or oval mass. *Podura atra*, Linn., &c.

Fig. 48.—Podura villosa.

[These insects have been greatly neglected by naturalists, but Dufour has described various species; and a valuable memoir is published in the first volume of the *Transactions of the Entomological Society of London*, upon the Irish species, by R. Templeton, Esq., R.A., comprising several new genera, and accompanied by beautiful figures. Some of his species, however, appear to me to be established upon the immature states of these insects. M. Guérin has also very recently presented to the Académie des Sciences, a memoir, in which he announces the existence of branchiæ in the *Machilis polypoda*, Latr.; the breathing apparatus* consisting of minute plates placed under the abdominal segments, and by the side of those appendages which are compared to the false legs of the Crustacea. They are inclosed in little membranous bags, of a similar organization to those of the respiratory organs of a great number of the inferior Crustacea. M. Guérin has still more recently figured them in his *Iconographie.*]

THE THIRD ORDER OF INSECTS,—

PARASITA, Latr., (ANOPLURA, Leach),—

(Or the Lice), thus named from its habits, have only six legs, and are apterous, like the Thysanoura; but the abdomen is destitute of articulated and moveable appendages. Their organs of sight merely consist of four or two small ocelli. The mouth is, for the most part, internal, and exhibits, on the outside, either a snout or fleshy porrected tubercle, inclosing a retractile sucker, or two membranous lips, close together, with two hooked mandibles. They compose, according to Linnæus, the single genus

PEDICULUS, Linn.

The body is flattened, nearly transparent, divided into eleven or twelve distinct segments, of which three, forming the trunk, have a pair of legs attached to each. The first of these segments often forms a kind of corselet. The spiracles are very distinct. The antennæ are short, of equal thickness throughout, composed of five joints, and often inserted in an excavation. Each side of the head exhibits one or two minute ocelli. The legs are short, and terminated by a very strong nail, or by two opposing hooks, whereby these animals easily fasten themselves to the hairs of quadrupeds or feathers of birds, of which they suck the blood, and upon the body of which they pass their lives, and there multiply, attaching their eggs to those cutaneous appendages. Their generations are numerous, and succeed each other very rapidly. Particular causes, unknown to us, are very favourable to their production; and this is especially the case in respect to the common Body Louse, in the disease named phthiriasis†, and also in infancy. They always live upon the same quadrupeds and birds, or at least upon the animals of those classes which have analogous characters and habits. One bird, however, often supports two kinds of Lice. They generally crawl very slowly.

Some species form the tribe Pediculidea of Leach, including

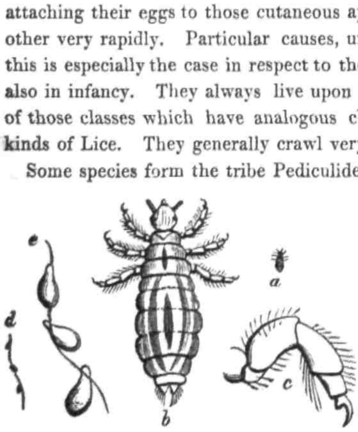

Fig. 49.—*a*, The Common Louse; *b*, magnified; *c*, one of the legs magnified; *d*, eggs; *e*, ditto magnified.

Pediculus, De Geer, which has, in the place of a mouth, a very small tubular tubercle, situated at the anterior extremity of the head, in the form of a snout, and inclosing, in inaction, a sucker. The tarsi are composed of a joint, in size nearly equal to the tibia, and terminated by a very strong hook, folding upon a prominent tooth at the extremity of the tibia, acting with it as a pincers. In those which I have examined, I have only seen two ocelli, one on each side. Man supports three kinds, their eggs being known under the name of Nits. The Body Louse (*P. humanus corporis*, De Geer), white, without spots, which multiplies excessively in the disease called phthiriasis, and the Head Louse (*P. humanus capitis*, De Geer), ashy colour, with darker spots, found only on the head of man, and especially of children, form Leach's genus *Pediculus*, having the thorax quite distinct from the abdomen. The *Pediculus pubis*, Linn., or Morpeon [Crabs, or Crab-lice], forms Dr. Leach's genus *Phthirus*, having the thorax very short, nearly con-

* [Latreille, in his elaborate memoir upon the organization of the Thysanoura, was unable to detect the ordinary spiracles for breathing.]

† [Alt, in his *Dissertatio de Phthiriasi*, Bonn, 1820, attributes this disease to another species (*P. tabescentium*), which, according to Burmeister, collect in great numbers upon the skin at particular parts of the breast, neck, and back, where the epidermis peels off. Burmeister attributes their appearance to equivocal generation.

founded with the abdomen, and the four hind legs very robust. (See Dr. Alibert's fine work upon the maladies of the skin.)

Other species, found upon different quadrupeds, have been figured by Redi, but in a coarse manner. That which lives upon the Pig has the thorax very narrow, with the abdomen very broad (*Pediculus Suis*, Linn., forming Leach's genus *Hæmatopinus*). The Louse of the Buffalo, figured by De Geer (*Ins.* vol. vii. pl. 1, f. 12), is more singular. (*Pediculus Cervi*, Panzer, belongs to the dipterous genus Melophagus.)

The other species (*Nirmidea*, Leach), such as *Ricinus*, De Geer, *Nirmus*, Herm. & Leach, have the mouth on the under side of the head, and composed, on the outside, of two lips, and of two hooks and mandibles. The tarsi are very distinct, articulated, and terminated by two equal nails.

With the exception of a single species, that of the Dog, all the rest are found exclusively upon birds. The head is generally large, sometimes triangular, or in the others in the form of a semicircle or crescent, and has often angular projections. It differs sometimes in both sexes, as well as the antennæ. I have perceived, in many species, two simple eyes close together, on each side of the head. According to observations communicated to me by M. Savigny, these insects have maxillæ, with a very small palpus upon each, hidden by the lower lip, which has also similar organs. They have, also, a kind of tongue.

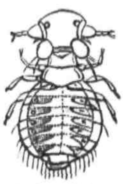

Fig. 50.—Ricinus Pavonis.

M. Leclerc de Laval has stated to me that he discovered, in their stomach, morsels of the feathers of birds, which he believes is their only food. De Geer asserts, nevertheless, that he found the stomach of the Ricinus of the Chaffinch filled with blood, with which it had gorged itself. It is also known that these insects can subsist but a very short time upon dead birds. They are then observed crawling, with uneasiness, upon the feathers, particularly upon those of the head, and near the beak. Redi has figured a great number of species, [as has also Lyonnet, in his posthumous memoirs].

Some species have the mouth situated near the anterior extremity of the head; the antennæ are inserted at the side, at a distance from the eyes, and are very small. *Pediculis Sternæ*, *Hirundinis*, Linn., &c.

In the other species, the mouth is nearly central; the antennæ placed very near the eyes, and their length is nearly equal to that of half the head. *Ricinus Gallinæ*, De Geer, &c.

A celebrated German naturalist, Dr. Nitzsch, deeply studied the internal and external anatomy of these animals, of which he published a memoir in *Germar's Magazine*. The true genus Pediculus, or the species provided with a suctorial mouth, is arranged by him with the Epizoical Hemiptera. The genus *Ricinus*, De Geer (*Nirmus*, Herm.), or the species provided with mandibles and maxillæ, are referred to the order Orthoptera, and collectively named *Mallophaga*. Two genera of the latter are allied to the former, in being found upon various Mammalia. They are *Trichodectes*, having the maxillary palpi obsolete, and living upon the Dog, Badger, &c.; and *Gyropus*, having distinct maxillary palpi, and living upon the Guinea-pig. The last-named genus has the mandibles entire, and the labial palpi obsolete, thus differing from *Liotheum*, which has the mandibles bidentate, the labial palpi distinct, and the tarsi terminated by two nails. The species are found on various birds, as are also those of the last genus, *Philopterus*, which have 5-jointed antennæ, the third often branched in the males, and the maxillary palpi are indistinct. We have not space to enumerate the subgenera into which Nitzsch has divided these genera, in all of which the pro- and mesothorax compose the trunk, the metathorax being soldered to the abdomen. The subgenus *Goniodes* is restricted to the gallinaceous birds. We have described a species of Philopterus in detail, in the collection of memoirs at the end of our *History of Ants*.

M. L. Dufour has formed a new genus (*Triongulinus*) for the *Pediculus Melittæ* of Kirby, previously observed by De Geer, who regarded it as the larva of *Meloe proscarabæus*. If it be not the larva of this insect, as Kirby supposed, doubtless it would form a distinct subgenus in the order Parasita; but Messrs. Serville and Saint Fargeau have confirmed De Geer's statement, [as it has also been by numerous recent English observers, as Doubleday, Newport, Newman, Jenyns, &c.]

[In addition to the species figured by Redi, De Geer, and Lyonnet, and those indicated (from the species of animals attacked), but not specifically described, by Nitzsch, various species have been described by L. Dufour in the *Annales de la Société Entomologique de France;* and by J. G. Children, Esq., in the Appendix to Captain Back's *Voyage to the North Pole*. Mr. Denny has also announced an illustrated monograph of the order.]

THE FOURTH ORDER OF INSECTS,—

SUCTORIA, De Geer, (SIPHONAPTERA, Latr., [APTERA, M'Leay; APHANIPTERA, Kirby]),—

Terminates the Apterous Insects, and has the mouth formed of a sucker of three* pieces, inclosed between the articulated plates, forming together a rostrum or beak, either cylindrical

* Rœsel only represents two, but Kirby and Strauss have observed one more. According to the latter, the scales covering the base of the beak are the palpi.

or conical, the base of which is covered by two scales. These characters exclusively distinguish it from all other insects, including the Hemiptera, with which it was ranged by Fabricius. The Suctoria, moreover, undergo real metamorphoses, analogous to those of many two-winged insects, as the Tipulidæ.

This order is composed of the single genus of Fleas,—

PULEX, Linn.

The body is oval, compressed, inclosed in a tough skin, and divided into twelve segments, of which three compose the trunk, which is short, and the others the abdomen. The head is small, very compressed, rounded above, truncate, and ciliated in front. It has, on each side, a small, round eye, behind which is a cavity, in which is placed a small, moveable body, furnished with minute spines. At the anterior edge, near the base of the beak, are situated the pieces which have been considered as the antennæ, which are scarcely so long as the head, and are composed of four nearly cylindrical joints. The sheath of the beak is composed of three joints. The abdomen is very large, and each of its segments is divided in two, being formed of two plates, one superior and the other inferior. The legs are robust, particularly the posterior, fitted for leaping, spinose, with the coxæ and thighs very large, and the tarsi composed of five joints, the last terminated by two long nails. The two fore-legs are inserted almost beneath the head, and the beak is placed between them.

The female lays about a dozen white, slightly viscid eggs, whence emerge small larvæ, destitute of legs, very much elongated, resembling minute worms, very active, coiling themselves up in a circle or spire, serpenting in their progress, at first white and afterwards reddish. Their body is composed of a scaly head, without eyes, bearing two very minute antennæ and thirteen segments, with small tufts of hairs and a pair of little hooks at the tip of the last. The mouth exhibits a few small, moveable parts, of which the larvæ make use in pushing themselves forwards. After living about twelve days under this form, these larvæ inclose themselves in a small silken cocoon, where they become pupæ, and from whence they make their escape in the perfect state, at the expiration of a similar period.

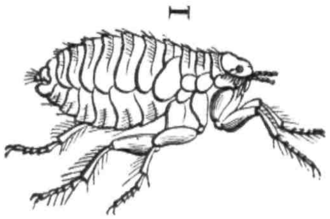
Fig. 51.—The Flea (*Pulex irritans*).

Every one knows the common Flea (*Pulex irritans*, Linn.), which feeds on the blood of Man, the Dog, and Cat. Its larva lives amongst dirt, and beneath the nails of filthy persons; also in the nests of birds, such as Pigeons, attaching itself to the necks of the young, and gorging itself till it becomes red. Well figured by Dumeril (*Consid. Générales sur la Classe des Insectes.*)—*Pulex penetrans*, Linn., probably forms a peculiar genus. Its beak is of the length of the body. It is known in America under the name of the Chigoe [or Jigger]. It introduces itself beneath the nails of the feet and the skin of the heel, where it soon acquires the size of a small pea, by the quick growth of the eggs, which it bears in a large membranous bag beneath the abdomen, the numerous family from which occasions, by remaining in the wound, an ulcer, very difficult to heal, which even sometimes becomes mortal. Frequent washings, and rubbing the feet with fresh tobacco leaves, or those of other bitter plants, are preventives against its attacks. The negroes [or more commonly the negresses] are in the habit of extracting the insect, with great skill, from its lodgement. Various quadrupeds and birds nourish Fleas, which appear to differ specifically from the two preceding.

[The structure of the head and mouth of these insects has been investigated by recent entomologists, especially by Curtis, Duges, and myself. The moveable organs noticed above, implanted in a cavity at the back of the sides of the head, are proved to be antennæ, varying considerably in form in various species. Their variations have led to the proposal of another genus for certain species, by Mr. Curtis. The two flat pieces noticed by Rœsel, are the lancet-like mandibles; the two conical scales at the base of the mouth are the maxillæ, the long antenna-like organs in front of the head being the maxillary palpi; the third piece, noticed above as described by Kirby, is the slender setiform tongue, and the two articulated plates above described are the labial palpi, arising from a common labium. Thus the mouth is seen to consist of all the essential parts, except an upper lip, which is obsolete in many other tribes. M. Duges has also detected two scales on each side of the meso- and metathorax, which he considers as the real analogues of the two pairs of wings.

Various species of Fleas have been described by Curtis, Duges, &c. The Chigoe has also been investigated by Duges, Guérin, and myself, from whence it appears that the large mass of eggs causes the abdomen to become immensely swollen. The mouth is of the ordinary type, but the lower lip is destitute of labial palpi, whence I have proposed for it the generic name of *Sarcopsyllus*, or Flesh-flea.]

THE FIFTH ORDER OF INSECTS,—

COLEOPTERA, Linn. (ELEUTHERATA, Fabr.),—

Have four wings, of which the upper pair is crustaceous, in the form of scales, horizontal, and meeting [when at rest] along the inner edge by a straight line. They have, likewise, mandibles and maxillæ, and the lower wings are folded only transversely, and covered by the other two, which form a kind of case, and which are generally known under the name of elytra.

These insects [generally known under the English name of Beetles] are the most numerous and the best known of the insect tribes. Their singular forms, the brilliant colours exhibited by many of their species, the size of their bodies, the more solid texture of their teguments, which renders their preservation much more easy, and the numerous advantages to be derived from the investigation of such a variety of forms of their external organs, have merited for them the particular attention of naturalists.

The head is provided with two antennæ of variable form, and of which the number of joints is generally eleven; two facetted eyes; no ocelli; and a mouth composed of an upper lip, two mandibles, mostly of a scaly consistence, two lower jaws (maxillæ), each bearing one or two palpi, and a lower lip formed of two pieces, namely, the mentum and the tonguelet (*languette*), and accompanied by two palpi, generally inserted upon this latter piece; those of the maxillæ, or the outer maxillary palpi (when they bear two), have never more than four joints, whilst those of the lower lip have, ordinarily, only three joints.

The anterior segment of the trunk, or that which is in front of the wings or elytra, and which is commonly named the corselet [prothorax], and which bears the first pair of feet, and greatly surpasses in extent the two other segments, which are compactly united together, as well as to the base of the abdomen: their under part, or the sternum or breast, serves as a point of attachment to the two other pairs of feet.* The second of these segments [or the mesothorax], upon which is placed the scutellum, is narrower in front, so as to form a short peduncle, which is received into the inner cavity of the first segment [or prothorax], and which serves as a pivot to assist in all its movements.

The elytra and wings arise upon the lateral and superior margins of the hinder division of the thorax, [or the meso- and metanotum]. The elytra are crustaceous, and in repose are applied one against the other in a straight line along the inner margin, or suture, and are always in a horizontal position. In almost every instance they hide the wings, which are large, and folded transversely. Many species are wingless; but the elytra are always present. The abdomen is sessile, or united to the thorax by its greatest width: it is composed on the outside of six or seven segments; membranous above, or of a consistence less firm than on the under side. The number of joints on the tarsi varies from three to five.†

Beetles undergo a complete metamorphosis. The larva resembles a worm, with a scaly head and mouth, analogous in the number and functions of its parts to that of the perfect insect, and also with six legs: some species, however, few in number, are destitute of these appendages, or have only simple fleshy tubercles.

The pupa is inactive, and does not take any nourishment. The habitation, mode of life, and other habits of these insects, both in their immature and perfect states, vary very much.

I have divided this order into *four sections*, after the number of joints of the tarsi.‡

* The mesothorax is always narrow and short, and the metathorax, often of larger size, is longitudinally impressed down the centre.

† Judging from analogy, the Coleoptera described as monomerous have probably three joints to the tarsi, but of which the two basal joints escape the view: this section, as well as the Dimera, have been suppressed in this edition.

‡ [The distribution of the Coleoptera, founded upon the number of joints in the tarsi, has been objected to by some authors, as it has the effect, if rigidly adhered to, of separating certain groups nearly related together: as, for instance, the Pselaphidæ (which have only 3-jointed tarsi), and the Staphylinidæ, which have 5-jointed tarsi. Some species are also anomalous in the number of the joints of their tarsi varying in the sexes. Another objection has been raised to the tarsal system, on the ground, that the so-called Tetramera have, in effect, 5-jointed, instead of 4-jointed tarsi; and the Trimera, 4-jointed, and not 3-jointed tarsi, as those names indicate. But these objections appear to me insufficient; due allowances must be made for certain exceptions against every rule; and the peculiar structure of the tetramerous or trimerous tarsi, equally merits their retention as distinct groups. Mr. M'Leay has proposed a classification of the Beetles, founded upon

The first section comprises the ***Pentamera,*** or those which have five joints in all the tarsi, and which consist of *six families,* of which the first two are distinguished by the possession of a double excrementitial apparatus.*

THE FIRST FAMILY OF THE COLEOPTERA PENTAMERA—

CARNIVORA, Cuv. (*Adephaga,* Clair.),—†

Which has two palpi to each maxilla, or six in the whole. The antennæ are almost always thread-like or setaceous, and simple. The maxillæ are terminated by a scaly piece or slender hook; and the inner edge is furnished with hairs or small spines. The tonguelet is received in a notch of the mentum. The two fore-legs are inserted upon the sides of a compressed sternum, by means of a large rotule; the posterior pair have a strong trochanter at the base; their basal joint is large, and appears to be soldered with the post-sternum, in the form of a curvilinear triangle, with the outer edge excavated.

These insects hunt after and devour other insects; many have no wings under the elytra. The anterior tarsi in many of the males are dilated.

Their larvæ are also very carnivorous. They have, in general, the body cylindric, elongated, and composed of twelve joints; the head (not counted in this number) is large, scaly, armed with two strong mandibles bent upwards at the point, with two short conical antennæ, two maxillæ, divided into two branches, of which one is formed by the palpus; a tonguelet, bearing two short palpi; and six small smooth eyes on each side. The first segment is covered by a scaly plate: the others are softer. Each of the anterior segments bears a pair of feet, of which the extremity is curved in front. These larvæ differ according to the genera. Those of the Cicindelæ, and *Aristus bucephalus,* have the upper side of the head deeply impressed in the middle, with its under side very globose. They have on each side two of the small smooth eyes much larger than the rest. The upper plate of the fore segment is large, and like a semicircular shield. The eighth segment has upon the back two hooked tubercles. The last segment has no particular appendages.

In the other larvæ of this family with which we are acquainted, with the exception of Omophron, the head is not so strong and regular on its upper side. The ocelli are very small, and all alike. The scaly back of the first segment is square, and does not extend beyond the side of the body. The eighth segment is destitute of tubercles, and the last is terminated by two conical appendages, as well as a membranous tube, formed of the elongation of the anal apparatus. These conical appendages are corneous and toothed in the larvæ of Calosoma and Carabus: they are fleshy, articulated, and longer in the Harpali and Licini. The form of the mandibles approaches that of the perfect Beetles. The larvæ of *Omophron limbatus,* according to Desmarest, is of a conical form, with a large head, and two very strong mandibles, and with only two eyes: the extremity of its body, which is gradually narrowed, is terminated by an appendage of four joints. I have only counted two in those of the larvæ of the Licini and Harpali.

These insects are either terrestrial or aquatic.

The terrestrial Carnivora have the legs fit only for running; the four posterior are inserted at equal distances apart: the mandibles are entirely exposed; the terminal piece of the maxillæ straight beneath, and bent only at the tip; the body generally oblong, with the eyes prominent. All the tracheæ are tubular or elastic. The intestine is furnished with two small sacs, which secrete an acrid humour. M. L. Dufour has presented (in the *Annales des Sciences Naturelles,* vol. viii. p. 36,) a resumé of the anatomical characters of these insects, [from which it appears that the digestive tube is not more than twice the length of the body; the gizzard is armed interiorly with moveable corneous

the forms of their larvæ; he has, however, only given a slight sketch, which recent discoveries do not seem to support. Mr. Kirby has also proposed another arrangement in the Fauna Borealis Americana, founded exclusively upon the general structure of the perfect insect.]

* Linnæus, Fabricius, and their followers commence the arrangement of the Beetles with the genus Scarabæus: which comprises some of the most bulky of the insect tribes, as, for instance, the Rhinoceros, Elephant, and Goliath Beetles. The arrangement of Latreille is founded upon the supposed superior developement of the masticatory organs of the Adephaga, and especially upon the circumstance of their possessing two pairs of palpi to each of the maxillæ. Mr. Hope, in the preface to the second part of his Coleopterist's Manual, has supported the Linnæan arrangement with various arguments.]

† This family, one of the most extensive of the insect tribes, has been illustrated by Weber, Clairville, Bonelli, and especially by Dejean in his *Species General,* [now completed by himself, as regards the land Carnivora, and continued by Dr. Aubé, as regards the aquatic species.]

pieces, fitted for trituration; and that the existence of a complicated apparatus for an excrementitial secretion, possessing ammoniacal qualities, is one of the most striking features of the Carabi.]

They are divided into two tribes.

The first, that of the *Cicindeletæ*, Latr., comprises the genus

CICINDELA, Linn.,—

Which have the tip of the maxillæ furnished with a corneous, slender hook, articulated at its base with these under jaws. The head is robust, with great eyes, jaws very advanced and toothed, and a very short tonguelet hidden behind the mentum. The labial palpi are distinctly composed of four joints; they are commonly hirsute, as well as the maxillary palpi. The majority of the species are exotic.

Some species have a tooth in the middle of the notch of the mentum, with the labial palpi wide apart at the base.

Manticora, Fab., has the tarsi alike in both sexes, with cylindrical joints. *Manticora maxillosa*, Fab. [and *M. latipennis*, Waterh.] from Caffraria. *M. pallida*, Fab., forming M'Leay's genus *Platychile*, [figured in *Klug's Jahrbucher*].

Those species which have the three basal joints of the anterior tarsi dilated in the males, with the body oblong or oval, and the thorax nearly square, compose the genera *Megacephala*, Latr., (with a transverse short upper lip); *Oxycheila*, Dej. (with a large triangular upper lip); *Euprosopus*, Latr., and *Cicindela* proper, which has the labial palpi not longer than the maxillary, the third joint of the former not manifestly thicker than the following joint, and the three dilated basal joints of the anterior male tarsi elongated.

The body of the last-named insects is generally of a darker or lighter green colour, varied with shining metallic tints, and with white spots upon the elytra; they frequent dry situations exposed to the sun, run very quickly, fly off when they are approached, and alight at a short distance; if again disturbed, they have recourse to the same means of defence.

The larvæ of two indigenous species, the only ones yet observed, burrow in the earth, forming a cylindrical hole of considerable depth, using their jaws and feet in its construction, and loading the concave back of their heads with the grains of earth which they have detached, with which they ascend backwards, resting at intervals, fixing themselves to the inner walls of their burrow by the assistance of the two hooked tubercles upon the back; when arrived at the orifice, they jerk off their load to a distance. Whilst lying in ambush the flat plate of the head exactly stops the mouth of the hole, forming a flat surface with the surrounding soil. They seize their prey with their jaws, and even rush upon it, precipitating it to the bottom of their burrows, with a see-saw motion of the head. They likewise descend them with equal quickness at the least danger. If they find them too narrow, or the nature of the earth is not favourable to them, they make a new burrow. Their voracity is even extended to other larvæ, even of their own kind, stationed in the same situations. They close the orifice of their burrow when they change their skin, or undergo their change to the pupa state. These observations have in part been communicated to me by M. Miger, who has greatly studied the larvæ of Coleoptera.

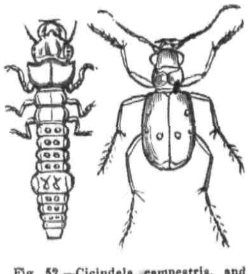

Fig. 52.—Cicindela campestris, and larva.

Cicindela campestris, Lin., is half an inch long, of an obscure green above, with the upper lip white, and with a slight tooth in the middle; each of the elytra with five small white dots. Very common throughout Europe, especially in the spring.

Cicindela germanica, Lin. [the smallest British species], and some others, are of a narrower form; they fly less than the foregoing. All these species are winged, but other exotic species are apterous, forming Dejean's genus *Dromica*.

Ctenostoma, Klug, has the body long and narrow, the thorax long and knotted, and the third joint of the male tarsi is produced on the inside into a plate. The species are from tropical America.

Therates, Latr. (*Eurychile*, Bonelli); *Colliuris*, Latr. (*Collyris*, Fab.); and *Tricondyla*, Latr., are three genera which have no tooth in the middle of the notch of the mentum, and the labial palpi are contiguous at the base. Therates has the form of Cicindela proper, but in the two others the body is long and narrow, and the thorax knotted. All the species of these three groups are peculiar to the East Indies and the islands of the adjacent Archipelago.

[The investigation of the family Cicindelidæ*, corresponding with the Linnæan genus Cicindela, or Cicindeletæ of Latreille, has been greatly pursued by modern continental authors, who have described a great many new species, chiefly exotic, and have added several new genera. Dejean's *Spécies Général*, Vander Linden's *Memoir on the Insects of Java*, Laporte de Castelnau, in various memoirs, Gory, Say, Klug, Guérin, Gistl, &c., have particularly studied this family; and in our own country M'Leay, Kirby, and Hope, in the 2nd part of *The Coleopterist's Manual*, have described many new species.]

* [English authors have generally adopted the plan first proposed by Mr. Kirby, in his "Century," of forming the Linnæan genera into natural families, corresponding with the "familles naturelles" of Latreille, and for which they retain the old Linnæan generic name, but with an uniform termination *idæ*.]

The second tribe, that of the *Carabici*, Latr., comprises the genus

CARABUS, Linn.,—

Which has the maxillæ terminated simply in a point or hook, not articulated at its base. The head is generally narrower, or at least not broader, than the thorax; the mandibles, except in a few instances, are destitute of or with very slight teeth; the tonguelet is generally exposed, and the labial palpi are only distinctly three-jointed, (the basal joint, which in Cicindela is detached, forming a fourth joint, being here entirely fixed, and forming a support to the palpus, and is accordingly not reckoned as a separate joint). Many species are destitute of wings, and have only elytra. They often emit a fetid odour, and discharge from the anus an acrid and caustic liquid.

Geoffroy considered that the ancients designated these insects under the name of *Buprestis*, and which they regarded as a dangerous poison, especially to oxen. (See the genus *Meloe*).

The Carabici conceal themselves in the earth, under stones, the bark of trees, &c., and are for the most part very active. Their larvæ have the same habits. This tribe is very numerous, and of difficult investigation.

We form a first general division with those in which the exterior [maxillary] palpi are not terminated by a minute conical joint, the last joint forming, with the preceding joint, an oval or conoid mass, with a sharp point at its tip.

Some of these have a deep notch on the inner edge of the anterior tibiæ, separating the two acute spurs, which are ordinarily placed at the apex of the limb. These constitute several [five] sections.*

1. The TRUNCATIPENNES, thus named from their elytra being almost invariably truncate at the posterior extremity. The head and thorax are narrower than the abdomen. Some have the ungues of the tarsi simple, or without teeth beneath. Of these the three following are destitute of wings.

Anthia, Weber, Fab., with the tonguelet horny, oval, and nearly as long as the palpi; the abdomen is oval, often convex, and the elytra are nearly entire, or scarcely truncate. These, as well as those of the next subgenus, have the body black, and with spots of white down. They inhabit the deserts and other sandy places of Asia and Africa. From an observation of De Latour, they eject from the anus, when disturbed, a caustic liquid. The species are generally of large size, and in the males of some the thorax is dilated more or less behind, and terminated by two lobes.

Graphipterus, Latr. long confounded with the preceding, but differing in the tonguelet, entirely membranous except in the centre; the abdomen is always flattened and orbicular. The species of this subgenus are exclusively African, and are much smaller than the preceding.

Aptinus, Bonelli, has the last joint of the exterior palpi, and especially of the labial palpi, evidently dilated, and a tooth in the middle of the mentum. But that which more particularly distinguishes them, and also the *Brachini*, is, that their abdomen, which is oval and thickened, contains organs which secrete a caustic fluid, escaping with an explosion from the anus, and instantly evaporating, with a penetrating scent. This fluid, when the animal is held between the fingers, produces upon the skin a spot similar to that made by nitric acid, and even, if the species be large, a painful burn. Dufour first made us acquainted with the organs by which it was secreted (in *Annal. du Mus. d'Hist. Nat.*, tom. xvii.). These insects are often found assembled in societies, especially in the spring, under stones. They make use of this defence to alarm their enemies, and they are able to repeat the explosion a considerable number of times. The larger species are found in the tropics and other hot countries, as far as the limits of the temperate zone. *A. Balista*, Dej. (*Brachinus displosor*, Dufour), inhabits Navarre and various parts of Spain and Portugal.

Brachinus, Weber, Fabr., differs only from Aptinus in being provided with wings, and the middle of the emargination of the mentum not toothed. *Brachinus crepitans*, Fabr., is found common in the environs of Paris [as well as in various parts of England]. It is generally four lines long, fulvous-orange, with the elytra dark blue or greenish blue, and the antennæ fulvous, the third and fourth joints being black. The breast, with the exception of the middle of the abdomen, is also fulvous. Other species are named, from their explosive powers, *B. bombarda*, *B. exhalans*, *B. causticus*, *B. sclopeta*, &c.

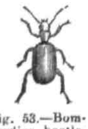
Fig. 53.—Bombardier beetle.

(*Catascopus*, Kirby, appears to us to belong to the section Simplicimani, from a recent investigation, rather than to this section.)

Corsyra, Stev., is placed by Dejean between Brachinus and Catascopus. The claws are simple; body flat, short, broad; palpi filiform.

The other Carabici of the same division have the ungues also simple, but the head is narrowed behind the eyes into a neck. In some the tarsi are nearly identical in the two sexes, subcylindrical or linear, the penultimate joint being alone deeply bilobed.

* [Mr. M'Leay and several more recent writers have cut up the Linnæan genus Carabus, or the family Carabidæ, into several divisions, each of which they have regarded as equivalent in value to the family Cicindelidæ. The views of Latreille, in regarding them as divisions of the primary group Carabiques, which is itself regarded, as a whole, of equal rank with the Cicindeletæ, correspond with those of Linnæus and Kirby.]

Casnonia, Latr. (having the thorax long and conical), *Leptotrachelus*, Latr., and *Odacantha*, Payk. (with the thorax nearly cylindrical, the elytra truncate, and the tarsal joints entire), are distinguished by having the outer maxillary palpi filiform, or scarcely thickened at the tip. *Od. melanura*, Fabr., Clairville, is three lines long, of a bluish green colour, with the elytra, except at the tip, of a reddish yellow; the tip of the elytra is bluish black. This species frequents aquatic places, and is commonly found in the departments of the north of France, Germany, and Sweden. [It is plentiful in similar situations in the fens of Lincolnshire, Whittlesea Mere, &c., and is found in quantities in the sedge boats which go to Cambridge.]

Those which have the outer maxillary palpi terminated by an enlarged triangular or obconical joint, and which have the body flattened and the tarsal joints entire, compose the three following subgenera, namely, *Zuphium*, Latr., *Polistichus*, Bonelli (consisting of a single British species, *P. fasciolatus*), and *Helluo*, Bon. [the last of which consists of numerous exotic species, the type being *H. costatus* of New South Wales]; whilst those which differ from the last in having the penultimate joint of the tarsi deeply bilobed, the jaws long and porrected, and the body thick, form the genus *Drypta*, Latr., Fabr., the type of which is the *D. emarginata*, Fabr., four lines long, of a fine blue colour, with the mouth, antennæ, and legs fulvous. It is more common on the south than the north of France. M. Blondel, however, found it abundantly near Versailles. [It is very rare in England, and has been found on the southern coast.]

Trichognatha, Latr., *Galerita*, Fabr., and *Cordistes*, Latr., are exotic genera [chiefly American], differing from the preceding in having the four basal joints of the anterior tarsi of the males greatly dilated, the fourth being constantly bilobed in both sexes.

The remaining Truncatipennes have the ungues of the tarsi finely toothed beneath, like a comb.

Ctenodactyla, Dej., and *Agra*, Fabr., have the head oval, and separated from the thorax by an abrupt neck; the fourth tarsal joint is always bilobed. The latter genus has the body very long and narrow, with the thorax of an elongated conical form, narrowed in front. The species are numerous, and inhabitants of South America.

The four following subgenera have the head not separated from the thorax by a distinct narrow knot or rotule; the body is flattened and elongated, and the thorax is longer than broad, heart-shaped, posteriorly truncated.

Cymindes, Latr. (*Tarus*, Clairv.), with the outer maxillary palpi filiform, the last joint cylindrical, but being in the labial palpi very large and hatchet-shaped, at least in the males, and all the joints of the tarsi are entire and nearly cylindrical. [The type is the *Carabus humeralis*, Fabr., a rare British insect; there are also several other British species.]

Calleida, Dej., having the fourth joint of the tarsi bifid. Peculiar to America.

Demetrias, Bon. Similar to the last in the tarsi, but with the palpi filiform, and the last joint nearly ovoid or subcylindrical. This and the following subgenera consist of very small species [many of which are British], and which for the most part frequent aquatic, moist, or shady places, and are nearly all natives of Europe.

Dromius, Bon. Generally apterous, with the tarsal joints entire, but in other respects agreeing with Demetrias.

In the rest the thorax is broader than long, broadly truncate behind.

Of these, *Lebia*, Latr. (and *Lamprias*, Bon.), have the middle of the posterior edge of the thorax prolonged into a transverse lobe; the four basal joints of the tarsi are nearly triangular, and the fourth is more or less bifid or bilobed. These insects are agreeably diversified in their colours, [being in fact some of the most elegant of the whole family. The type of Lebia is the *Carabus crux minor*, Lin., of a fulvous colour, with a black head, and an irregular-shaped black cross on the back of the elytra. It is very rare in England.] The type of Lamprias, the *Carabus cyanocephalus*, Lin., is about three lines long, of a shining blue or green colour above, with the basal joint of the antennæ, the thorax, and feet, reddish yellow, and the tips of the thighs black. It is a rather common species throughout Europe. Others have the thorax terminated in a straight line, without an advanced lobe, namely, *Plochionus*, Dej., *Orthogonius*, Dej., and *Coptodera*, Dej., all consisting of exotic species; near the last of which ought probably to be arranged the subgenus *Hexagonia*, Kirby.

[" The subfamily Truncatipennes [or the *Brachinidæ* of M'Leay] as at present constituted, is, perhaps, the most incongruous of all the subfamilies of the Carabidæ, the term Truncatipennes, applied to it by Latreille, by no means indicating a constant character, as many of the species have the elytra rounded at the tips. The tarsi are indeed generally alike in both sexes, or, if dilated in the males, the dilatation is of a different character from that of the other subfamilies. It may indeed be rather regarded as a convenient receptacle for such groups as have not the bipartite and palmated structure of the Scaritides, the simple tibiæ of the Carabides, the dilated male tarsi of the Harpalides and its subdivisions, or the minute conical terminal joint of the maxillary palpi of the Bembidiides." (*Introd. to Mod. Class. of Insects*, vol. i. p. 75.) The family has been greatly studied, and a vast number of new species described, together with many new genera; but these have been established upon slight structural characters, and as they are for the most part exotic, I have not thought it advisable to detail them.]

2. The second section, that of the BIPARTITI, or the SCARITIDES, Dej., and which may from their habits be also called Fossores or Burrowers, is formed of Carabici with the elytra entire or slightly sinuated at the posterior extremity, the antennæ often necklace-like and elbowed [at the extremity of the long basal joint], the head broad, the thorax large, ordinarily in the shape of a cup, or nearly

semiorbicular, separated from the abdomen by an interval, which makes it appear pedunculated; the legs are generally but slightly elongated, with the tarsi often short, alike or scarcely different in the two sexes, without a cushion on the under-side, and merely furnished with the ordinary hairs or ciliæ; the two anterior tibiæ are toothed on the outside, as though palmated, or furnished with fingers, in many species, and the mandibles are often strong and toothed; the notch of the mentum is armed with a tooth. They are all found on the ground, hiding themselves either in burrows which they have dug, or under stones, and often quitting their retreats only during the night; their colour is generally of an uniform black. The larva of *Ditomus bucephalus*, the only one yet observed, has the form and mode of life of the Cicindelæ. They are particularly natives of hot climates.

The three following subgenera have the labial palpi terminated by a large hatchet-shaped joint.

Enceladus, Bon., has the anterior tibiæ without any internal notch, and not palmated externally. The thorax is heart-shaped, broadly truncated. Type, *E. gigas*, Bon., from the coast of Angola.

Siagona, Lat. (*Cucujus* and *Galerita*, Fabr.), has the fore tibiæ not palmated, but the notch on the inside is distinct; the basal joint of the antennæ is elongated. Some species have the abdomen oval, and are apterous (*S. rufipes*, &c.). In others, it is oval, truncated at the base, and these species are winged. They inhabit northern Africa or the East Indies.

Carenum, Bon., has the antennæ moniliform, the anterior tibiæ toothed on the outside, thus resembling Scarites; the maxillæ are straight, without any terminal tooth. Type, *Scar. cyaneus*, Fabr., from New Holland.

All the remaining Scaritides have the labial palpi terminated by an elongated, nearly cylindrical joint, narrowed at the base; the last joint of the maxillary palpi is also subcylindrical.

A first very natural subdivision comprises the Scarites of Fabricius (except the last mentioned species), which have the two fore-legs palmated or fingered at the tip, that is, terminated exteriorly in a long point or spine, opposed to a very strong inner spur. The antennæ are moniliform, with the second joint as long and often longer than the following. The mandibles are robust, advanced, and toothed on the inside.

Some of these have the mandibles very strong, protruded, and toothed, the upper lip crustaceous, and very much toothed on the fore margin; the fore tibiæ are always palmated, and the species are generally of large size.

Pasimachus, Bon., approaches the last in respect to the maxillæ, which are straight, and without any terminal hook; the body is very flat, thorax heart-shaped, broadly truncate behind. This subgenus is confined to America.

Scapterus, Dej., is placed by its author next the preceding, but the form of the body is long and cylindrical. I do not, however, know if the maxillæ are similar. It is founded upon a species from the East Indies, named *Scapterus Guerini*.

The following have the maxillæ arched and hooked at the tip; the thorax is always separated behind from the base of the elytra by a decided space.

The three following subgenera are distinguished by the external palpi being terminated by a nearly cylindrical joint, not narrowed at tip.

Acanthoscelis, Latr. (distinguished by the four posterior curved and flattened tibiæ, covered with minute points; Type, *Scarites ruficornis*, Fabr.; an inhabitant of the Cape of Good Hope.

Scarites, Fabr. (having the four hind tibiæ straight and naked, the mandibles of a triangular form, strongly toothed at the base). Type, *Scarites Pyracmon*, Bon. (*Sc. gigas*, Oliv.); about one inch long, found on the shores of the Mediterranean, the south of France, &c.; *Scarites terricola*, Bon., found with the preceding; *Scarites sabulosus*, Oliv., &c.

Oxygnathus, Dej., essentially like Scarites, but with long, narrow mandibles, without teeth, closing like a pair of pincers, and the body long, narrow, and cylindrical. Type, *Scarites elongatus*, Wiedeman; an inhabitant of the East Indies.

Oxystomus, Latr. (with the labial palpi nearly as long as the outer maxillary, with the last joint spindle-shaped, —type, *O. cylindricus*, Dej., Brazil); and *Camptodontus*, Dej. (with the labial palpi considerably shorter than the outer maxillary, with the last joint spindle-shaped,—type, *C. cayennensis*, Dej.), are both distinguished by their elongated, cylindrical body, and long, narrow, toothless mandibles.

The others have the anterior tibiæ not dentated on the outer edge, but simply didactyle at the tip; the mandibles short, but slightly advanced beyond the labrum, which is coriaceous and entire, and the outer palpi terminated by an oval joint, sharpened at the tip. They are of small size, frequent damp places, and occur in our northern regions.

Clivina, Latr., has three strong teeth on the outer edge of the two anterior tibiæ, and one on that of the two following. Type, *Tenebrio fossor*, Lin., (*Scarites arenarius*, Fabr.). [A very common British species, about a quarter of an inch long.]

Dyschirius, Bon., which has only small teeth or small indistinct spines on the outer edge of the two anterior tibiæ, the tip of which is produced into a long point; the thorax is nearly globose. The *Clivinæ*, Nos. 8—21 of Dejean, but the eighth, or *C. arctica*, appears to possess the characters of Cephalotes. [These species, of which *D. gibbus* is the type, are amongst the most minute of the Carabidæ; the species are rather numerous, and very difficult to be determined. The *C. arctica* has been formed by Eschscholtz into the genus *Miscodera* (*Leiochiton*, Curtis, *Oncoderus*, Stephens), and belongs, as Latreille indicates, to the family Harpalidæ.]

Our second and last subdivision of the Scaritides comprises those which have the anterior tibiæ neither

toothed on the outside nor bidigitate at the tips, and the second joint of the antennæ is evidently shorter than the following. They nearly approach, in the organs of the mouth, the two last subgenera; and have been confounded, by some writers, with Scarites, of which they have the appearance.

Morio, Latr. (with the antennæ of equal length throughout, thighs oval, and tibiæ triangular, *Harpulus monilicornis*, Latr. &c.), and *Ozæna*, Oliv. (with the antennæ thickened at the tips, and the femora and tibiæ narrow and elongated, *Ozæna dentipes*, Oliv. &c.), have the body narrow, elongated, nearly parallelopiped, the thorax nearly square, and the last joint of the external palpi nearly cylindric. All the species are exotic.

Those which have the body oval or oblong, with the thorax nearly cup or heart-shaped, or orbicular, the last joint of the outer palpi nearly oval or fusiform, and the labrum notched, compose the remaining genera.

Ditomus, Bonelli, have the palpi shorter than the head, the thorax cup or heart-shaped, and the tarsi short. Some species, to which Zeigler restricts the generic name, have the body more elongated, the head separated at the sides from the thorax by an angular space, and often armed in the males with horns; whilst the others, which form the genus *Aristus*, Zeigl., have the body shorter, broader in front, and the head and thorax nearly continuous.

Apotomus, Hoffm., have the anterior palpi very long, the thorax orbicular, and the tarsi filiform and elongated. Type, *Scarites rufus*, Oliv. [South of Europe.]

[The typical insects of this section, from the observations of M. Lefebvre de Cerisy, appear to be nocturnal in their habits; and hence their colours are, for the most part, black or obscure. The larger species are chiefly inhabitants of the Old World. They burrow in the earth, or sand of the sea-shore, for which their palmated fore-legs well fit them. They are insects of prey, lurking by day in holes and under stones, and feeding at night upon Melolonthidæ, or other soft-bodied insects. No generic additions of importance have been made to this group.]

3. Our third section of the *Carabici*—that of the QUADRIMANI, or HARPALIENS of Dejean—comprises those which, in other respects similar to the last in the elytra terminated posteriorly in a point, have the four anterior tarsi dilated in the males, the three or four basal joints being in the shape of a heart reversed, or triangular, and nearly all of them terminated by acute angles. Their under-side is generally (except in Ophonus) furnished with two rows of papillæ or scales, with a broad space between. The body is always winged, generally oval, and arched or convex above, with the thorax broader than long, or at most nearly isometrical; the head is never suddenly narrowed behind; the antennæ are of equal thickness throughout, or but very slightly thickened towards the tips; the mandibles are not very strong; the tooth in the notch of the mentum is always entire, but it is wanting in some species; the tonguelet is truncated at the tip, and accompanied by two ear-like membranous paraglossæ; the legs are robust, and the ungues of the tarsi simple; the intermediate tarsi, as in the females, are short, and, with the exception of the dilatation, are similarly formed to the anterior pair.

These Carabici frequent sandy situations exposed to the sun. This section is composed of the genus *Harpalus*, as restricted by Bonelli. New groups have since still further diminished its extent. They consist of the three following divisions:—

The first of these divisions has for its characters,—notch of the mentum with a single tooth, labrum notched, and the head and fore part of the thorax as broad as, or broader than, the abdomen.

Acinopus, Zeigl., with filiform antennæ, the joints short but cylindrical, the thorax narrowed gradually from the front to the back, and the hinder angles very obtuse. Type, *Harpalus megacephalus*, Latr. [South of Europe.]

Daptus, Fischer, with the antennæ moniliform after the fifth joint, and the thorax narrowed suddenly towards the posterior angles, which are pointed. Type, *D. pictus*, Fischer: Russia. *Pangus*, Megerle (*P. pensylvanicus*), does not appear to me to differ essentially from Daptus.

The second of these divisions is composed of Harpaliens having also the notch of the mentum one-toothed, but of which the body is more or less ovoid or oval, and narrowed in front, with the labrum entire, or slightly concave. These are the true *Harpalus*, Dejean, of which one of the most common species is the *Harpalus æneus*, Fabr., about one-third of an inch long, of a shining black colour, with the antennæ and legs yellowish, the upper surface generally green or coppery, and very brilliant. It has also been called *Proteus*, from the numberless changes in its colours. [The genus, even in its restricted state, is very numerous, and requires revision. There appear to be several British species still undescribed, in addition to the great number recorded by Stephens, Curtis, &c.]

The third of these divisions is distinguished by the absence of a tooth in the notch of the mentum. In other respects, however, it agrees with the preceding division.

Ophonus, Zeigl., has the four anterior tarsi of the males strongly dilated, or evidently larger, and generally furnished beneath with numerous hairs, forming a continuous brush. The penultimate joint is not bilobed, and the upper surface of the body is finely punctured. [There are numerous British species (including the *Harpalus obscurus*, Fabr.), chiefly found on the sea-coast.]

Stenolophus, Zeigl., differs in having the penultimate joint of the four anterior tarsi—at least in the males, and the same in the posterior tarsi in some species—divided to the base into two lobes. Type, *Carabus vaporariorum*, Linn., &c.

Acupalpus, Latr., in which the four anterior tarsi differ but slightly from the posterior, with the intermediate joints rounded, nearly moniliform, and villose. The outer palpi are terminated by a joint pointed at the tip. They are very small, and seem to unite with Trechus. Type, *Carabus meridianus*, Linn., [a very common little English species].

[Many additional genera, allied to Harpalus, have been separated by Dejean, Laporte, Chaudoir, Erichson, and other continental Entomologists; but they are, for the most part, founded upon minute structural characters, not requiring notice in this edition.]

4. The fourth section, SIMPLICIMANI, approach the preceding in the manner in which the elytra are terminated; but the two anterior tarsi are alone dilated in the males, without forming a square or orbicular plate. Sometimes the first three joints are evidently larger, and the following is always much smaller than the preceding. Sometimes this and the two preceding are broader, nearly equal, in the shape of a heart reversed, or triangular. The basal joints of the four succeeding tarsi are slenderer and longer, nearly cylindrical, or in the shape of a long reversed cone. Some have the ungues of the tarsi simple, or without teeth.

In a first subdivision, of considerable extent, the third joint of the antennæ is at most as long again as the preceding joint; the legs robust; and the thorax, in its broadest part, as wide as the elytra. Sometimes the mandibles are evidently shorter than the head, and do not extend beyond the labrum more than half their length.

We commence with those which have all the outer palpi filiform.

Zabrus, Bonelli, has the last joint of the maxillary palpi sensibly shorter than the preceding, and the two anterior tibiæ are terminated by two spines. Type, *Carabus gibbus*, Fabr., [a species of not very common occurrence in this country, and which has been ascertained to feed upon growing corn].

Pogonus, Zeigl., which in the natural order appears allied to Amara, has the two basal joints alone, of the anterior tarsi, dilated in the males, the basal joint being the largest. The body is more oblong. These insects appear exclusively to inhabit the sea-coast, or the shores of salt water. [*Harpalus luridipennis*, Germar.]

Tetragonoderus, Dejean, has the anterior tarsi of the males proportionately less dilated than in the following, the basal joints being narrower and more elongated, and rather in the shape of a reversed cone than a heart. They are peculiar to South America. [*Harpalus circumfusus*, Germar.]

Feronia, Latr., has the anterior tarsi of the males, with the three first joints strongly dilated, obcordate, with the second and third rather transverse than longitudinal. This subgenus comprises a great number of generic groups, indicated by Dejean in his Catalogue, which are as follow:—*Amara*, *Pœcilus*, *Argutor*, *Omaseus*, *Platysma*, *Pterostichus*, *Abax*, *Steropus*, *Percus*, *Molops*, and *Cophosus*. Dejean, however, having perceived the difficulty of characterizing them, united them all, with the exception of the first, into a great generical group, for which he retained my name *Feronia*. But as to *Amara*, I have in vain searched for characters to distinguish it from the other genera. That derived from the tooth of the notch of the mentum, not to speak of its unimportance, is a very equivocal character. This tooth, in all these Carabici, appears to me to have a notch at its tip, but rather more distinct and deep in some than in others. The moniliform structure of the antennæ of some of the groups appears to me not to be assignable with precision to the limits of such groups. I may say the same of the concavity of the front margin of the labrum, and the form of the thorax.

The *Feroniæ* may be arranged in three sections.—1st. The species generally winged, which have the body more or less oval; slightly convex or arched above, with the antennæ more filiform; the head proportionally narrowed, and the mandibles rather less exposed. In their habits they appear to approach Zabrus and Harpalus. Such are *Amara**, with the thorax transverse; *Pœcilus*, in which it is nearly as long as broad, and the antennæ are short, with the third joint compressed and angular; and *Argutor*, similar to *Pœcilus*, but with longer antennæ, of which the third joint is not angulated.—2nd. The species generally winged, but with the body straight, flat, or horizontal above, and the head nearly as broad. Such are *Platysma*, Bon.; to which we may unite that of *Omaseus* and *Catadromus*, Macl.—3rd. The species analogous to the preceding in their general characters, but which differ in wanting wings. The majority of these have the thorax not uniformly cordate or truncate, and the elytra have a transverse fold at the base. Sometimes the thorax is nearly square or truncate-cordate, with the posterior angles acute; (genera *Cophosus*, Zeigl.; *C. cylindricus*, Austria, having the body oblong, square, or cylindrical, and *Abax*, Bonelli, having the body generally oval, depressed, or slightly convex—type, *Carabus striola*, Fabr., [a common British species], found in the cold and moist parts of forests, &c.), whilst sometimes the thorax is terminated behind in two acute angles, and evidently narrowed. Those species with the body depressed on the upper side form the genus *Pterostichus*, Bonelli; whilst those with the upper side of the body more convex form the genus *Molops*; from the former of which *Steropus* has been detached, having the posterior angles of the thorax rounded. We terminate the subgenus with species of large size, in which the thorax is always truncate-cordate, and the base of the elytra has not the transverse fold. Such is the chief character of *Percus*, Bonelli—type,

* Some species of very short stature form the genus *Leirus* of some writers. *Scolytus flexuosus*, Fabr., appears to belong to this division, but Dejean says that the four anterior tarsi are dilated, but they appear to him to be more so on the outside than on the inner edge. Hence it may form a separate genus, *Cyclosomus*.

Carabus Paykullii, Rossi. The species exclusively inhabit Spain, Italy, and the isles of the Mediterranean. [The genus *Feronia*, as here described, is of very great extent, and on this account the characters which separate the different groups of which it is composed (and which are considered by many writers as so many distinct genera) blend so into each other that it is almost impossible to assign their limits with precision. Hence Dejean united them all into one genus, (for which Mr. Hope proposes the name of *Thalia*, *Feronia* having been long previously used by Leach for a genus of Diptera,) although, in examining a local collection of small extent, as that of England, the paucity of the number of species renders the assigning of characters apparently much more easy.]

Myas, Zeigl., resembles *Abax* (*Cheporus*, Latr.) *metallicus*; but the thorax is more dilated at the sides, with a slight notch in front of the posterior angles. *M. chalybæus*, Hungary. Here are also to be arranged the genera *Trigonotoma*, Dej., formed of large Indian species, and *Pseudomorpha*, Kirby.

Sometimes the mandibles are as long as the head, and the body always oblong. The first two genera resemble Scarites, and the others Lebia.

Cephalotes, Bon. (*Broscus*, Panz.), with the antennæ not longer than half the body; with short joints, and the labrum entire. [Type, *Carabus cephalotes*, Fabr.]

Stomis, Clairv., with the antennæ longer than half that of the body, with long joints, and the upper lip notched. [Type, *Stomis pumicatus*, Clairv., a common British species.]

Catascopus, Kirby, differs from the preceding in having the body flattened and broader, with the thorax shorter, the elytra strongly emarginated at the tips, and the upper lip elongated. The eyes are large and prominent. They are of brilliant colours, and resemble at first sight Cicindelæ or Elaphri. The species are from India. Type, *C. Hardwickii*, Kirby. The genus is closely allied to *Pericalus*, M'Leay, which have also the eyes very prominent, but the proportion of the joints of the antennæ is different. Type, *P. cicindeloides*, M'Leay; Java.

In a second subdivision, of much smaller extent, the length of the third joint of the antennæ is triple that of the preceding; these organs and the legs being slender.

Colpodes, M'Leay, has the four basal joints of the anterior tarsi of the males large, the penultimate being bilobed. Type, *C. brunneus*, M'Leay; Java. The others have the tarsal joints entire in both sexes.

Mormolyce, Hagen., has the body very flat, like a withered leaf; very much narrowed in front; the head is very long; the thorax oval, truncate at both ends; the elytra are very greatly dilated, and curved on the outside with a very deep notch at the tip. The only species, *M. phyllodes*, Hagenb., is from Java. [It is one of the most singular of known Coleopterous insects. Its true relations are, however, to be found amongst the Truncatipennes, as proved by the researches of Count Mannerheim and M. Serville.]

Sphodrus, Clairv., has the body depressed, but not foliaceous; the head ovoid, and the elytra not laterally dilated. Type, *Carabus leucopthalmus*, Linn. [A common British species, of large size.]

The terminal Simplicimani are distinguished from all the others by the minute teeth on the under-side of the ungues, at the tips of the tarsi.

Pristonychus, Dej. (*Ctenipus*, Latr.), has the body elongated, with the thorax heart-shaped, truncate behind. Types, *Sphodrus janthinus* and *complanatus*; but this genus insensibly blends into the preceding.

Calathus, Bon., has the body oval, arched above, and with the thorax square. Type, *C. melanocephalus*, Fab. [A very abundant and pretty British species.]

Taphria, Bon. (*Synuchus*, Gyll.), differs from the preceding in having the labial palpi terminated in a mass like a reversed cone, and the thorax nearly orbicular. Type, *Carabus nivalis*, Illig.

5. The fifth section, PATELLIMANI, is distinguished from the preceding only by the manner in which the two anterior tarsi of the males are dilated, the basal joints (generally the first three in some, or the first two only in others) being either square, or partially of this form, and the others in form of a heart or reversed triangle, but always rounded at their extremity, and not terminated, as in the preceding sections, by acute angles, forming an orbicular or oblong plate, of which the under-side is most commonly furnished with brushes of hairs, without any central naked space. The legs are commonly long and slender, and the thorax is often more narrowed throughout its whole length than the abdomen. They frequent, for the most part, the sides of rivers, or other aquatic places.

We divide the *Patellimani* into two divisions. In the first, the head is insensibly narrowed behind at the base. Some of these have the mandibles always terminating in a point, and the plate of the [fore male] tarsi is always narrow, elongated, and formed of the three basal joints, of which the second and third are square. The labrum is entire, or without an evident notch; and one or two teeth in the notch of the mentum. The following have the under-side of the tarsi furnished with two rows of papillæ, as in the preceding:—

Dolichus, Bon., has the body very flat, and the tarsal claws are toothed beneath. The thorax is in the form of a truncated heart. Type, *Carabus flavicornis*, Fabr.

Platynus, Bon., similar to Dolichus in the form of the thorax, but with the ungues of the tarsi simple. The wings are wanting, or are imperfect, in some species. Type, *Carabus angusticollis*, Fabr., [a common British species.]

Agonum, Bon., has the thorax nearly orbicular. Type, *Harpalus viduus*, Gyll. and others; [a common British species.]

Anchomenus, Bon., differs from the three preceding genera in having the body of the ordinary thickness, and the thorax always in the shape of a truncated heart. Type, *Carabus prasinus*, Fabr. and others.

The following have the under-side of the plate of the tarsi furnished with a close and continued brush. The outer palpi, and those of the labium, are terminated, in many, by a thicker or broader joint, like a reversed triangle:—

Callistus, Bon., has the tooth of the mentum entire, and the outer palpi terminated by an oval joint, pointed at the tip. Type, *Carabus lunatus*, [a rare British species].

Oodes, Bon., differs in having the last joint of the outer maxillary palpi cylindrical, and of the labial palpi oval and truncated. The thorax is trapezoidal, and narrowed in front. Type, *Carabus helopioides*, Fabr.

Chlænius, Bon., has the tooth of the mentum bifid, the outer maxillary palpi terminated by a nearly cylindrica joint, and the labial by a reversed conical and elongated joint. *Carabus cinctus*, Fabr., and many others, belong to this subgenus; as does also the *Carabus saponarius*, Oliv., used in Senegal by the natives instead of soap.

Epomis, Bon., has the outer palpi terminated by a broader compressed joint, in the shape of a hatchet, and is most dilated in the males. The tooth of the mentum is always bifid. Type, *E. circumscriptus*, Dejean, and many others. *Dinodes* and *Lissauchenius*, M'Leay, also nearly approach Epomis.

The others have generally the mandibles very obtuse and truncated, and bidentate at the tip. The upper lip is distinctly bilobed, the notch of the mentum is not furnished with a tooth, and the dilated portion of the tarsi is broad, and nearly orbicular. Some have the mandibles terminated in a point, without any notch or tooth near the tip; and the plate of the male tarsi is formed of the three basal joints.

Rembus, Latr., has the upper lip bilobed; the outer maxillary palpi are filiform; and the last joint of the labial is slightly thickened, and in the form of a reversed cone. Type, *Carabus politus*, Fabr.

Dicælus, Bon., has the upper lip merely emarginate, with a central impressed line. The last joint of the outer palpi is nearly hatchet-shaped, and the body almost parallelopiped. The species are from America.

Others have the mandibles very obtuse, notched at the tip, or with a tooth below it.

Licinus, Latr., has the last joint of the outer palpi almost hatchet-shaped. The plate of the male tarsi is broad and suborbicular, formed of the two basal joints. Type, *Carabus silphoides*, Fabr.; *C. depressus*, Paykull: [rare British species].

Badister, Clairv. (*Amblychus*, Gyll.), has the last joint of the outer palpi oval; that of the labial palpi is slightly longer, and often pointed. The plate of the male tarsi is long and square, formed of the three basal joints. Type, *Carabus bipustulatus*, Fabr., [a common British species].

In the second division of the *Patellimani*, the head is narrowed suddenly behind the eyes, as though attached to the thorax by a peduncle. It is often small, with the eyes prominent.

Pelecium, Kirby, has not a tooth in the notch of the mentum; the mandibles are robust, and the upper lip nearly bilobed. The four basal joints of the anterior male tarsi are in the shape of a reversed triangle. Type, *P. cyanipes*, Kirby; South America. In the following, there is a tooth in the notch of the mentum, and the upper lip is nearly straight.

Cynthia, Latr., has the outer palpi terminated by a hatchet-shaped joint. The head is small, and the basal joints of the male tarsi are of a reversed triangular form. Founded upon a Brazilian species, having the appearance of Abax.

Panagæus, Latr., has the tarsal plate of the males formed only of the two basal joints. The head is very small, with the eyes globular. The parts of the mouth are also very small, and the thorax often suborbicular. Type, *Carabus Crux major*, Fabr., [a rare British species].

In the two following subgenera, the outer palpi are filiform:—

Loricera, Latr., is very remarkable, having the second and four following joints of the antennæ furnished with strong bristles. The maxillæ are bearded on the outside, the labial palpi are longer than the maxillary, and the three basal joints of the fore tarsi are dilated in the males. Type, *L. ænea*, Latr. (*Carabus pilicornis*, Fabr.), [a very common British insect].

Patrobus, Megerle, has the antennæ filiform, straight, and without whorls of hairs; the mandibles are of the ordinary size; the length of the labial palpi does not exceed that of the maxillary; the two basal joints of the anterior tarsi are alone dilated in the males. Type, *Carabus rufipes*, Fabr., [a species very abundant on the summit of Snowdon, and other high mountains].

We now pass to those Carabiques which have the anterior tibiæ destitute of a notch on the inside; or which, if they do exhibit one, commences very near the tip of these tibiæ, or does not extend upon the fore face, but forms only an oblique and linear canal. The tonguelet is often very short, terminated in a point in the middle of the tip, and furnished with paraglossæ, also pointed. The mandibles are robust. The last joint of the outer palpi is generally very large, compressed in the form of a reversed triangle or hatchet in some, or nearly spoon-shaped in others, and often more swollen in the males (*Procerus*). The eyes are very prominent; the elytra are entire, or simply sinuated at the posterior extremity; and the abdomen is generally voluminous, compared to the rest of the body. These Carabiques are, for the most part, of large size, ornamented with brilliant metallic colours. They run very quickly, and are very carnivorous. They constitute a peculiar section (the sixth) in the group, and which we name GRANDIPALPI.

Those which have the body robust and wingless, with a bilobed labrum, the last joint of the outer palpi always very large, the notch of the mentum without a tooth, the inner edge of the mandibles

toothed throughout, or nearly throughout, its whole length, compose a first division, consisting of the following subgenera:—

Pamborus, Latr., has the mandibles curved, and strongly toothed throughout the whole length; and the outside of the tibiæ is produced at the tip into a point. The last joint of the outer palpi is semi-oval and longitudinal. *P. alternans*, Latr., from New Holland. [Several other species are described in a monograph by M. Gory, in Guérin's *Magasin de Zoologie*.]

Cychrus, Latr., has the mandibles straight, and simply curved at the tip; the anterior tibiæ are not produced into a point at the tip; the tarsi are alike in both sexes; the thorax is in the form of a truncated heart, or nearly orbicular, with the posterior angles obsolete. [Type, *C. rostratus*, Fabr.; a not uncommon British species.]

Scaphinotus, Latr., has the three basal joints of the fore tarsi of the males dilated but slightly, and in the form of a plate; the thorax trapeziform and broad, with the posterior angles acute, and turned upwards. *Cychrus elevatus*, Fabr.; North America.

Sphæroderus, Dejean, has the aspect of Cychrus; but with the two basal joints of the anterior male tarsi very broad, and forming a broad plate. [*S. Lecontei*, Dejean; North America.]

[Dr. Harris has just published (1839) a memoir on Cychrus in the *Boston Nat. Hist. Soc. Transactions*, in which he suggests that the different genera separated therefrom ought to be expunged.]

A second division is formed of those species which have also the body robust, generally wingless, but with the mentum furnished with an entire or bifid tooth, and the mandibles armed with one or two teeth situated at the base; the thorax is in the form of a truncated heart; the abdomen is often oval.

Tefflus, Leach, has the labrum entire, and the tarsi are alike in both sexes. *T. Megerlei*, nearly two inches long. From the coast of Guinea. The last joint of the maxillary palpi is very large, and hatchet-shaped. [M. Brullé has removed this genus to the group containing Panagæus, with which it agrees in the majority of its characters.]

Procerus, Meg., has the labrum bilobed, with the tarsi alike in both sexes. *Carabus scabrosus*, Fabr. &c.

All these species are of large size, entirely black or blue, or green above, with the elytra very much chagrined. They inhabit the mountains of the east of Europe, Caucasus, Libanus, &c.

Procrustes, Bon., has the labrum bilobed, and the tooth of the notch of the mentum bifid; the fore tarsi of the males is dilated. *Carabus coriaceus*, [a reputed British species].

Carabus, Linn. (*Tachypus*, Web.), has the labrum simply notched or bilobed, and with the tooth of the mentum-notch entire; the fore tarsi dilated in the males; they are destitute of wings. Dejean describes one hundred and twenty-four species, divided into sixteen sections. The majority of these species inhabit Europe, Caucasus, Siberia, Asia Minor, Syria, and the north of Africa. Some have been brought from the two extremities of America; and it is probable that the intermediate countries possess others. *Carabus auratus*, Linn., Panz., is a common continental species, which has received the ordinary name of the Gardener, [being found in gardens, where it feeds upon Worms. There are nearly twenty British species, the nomenclature of several of which is very confused in its synonymes. One of the largest and best characterized species is *C. clathratus*, a rare Irish insect, here figured.]

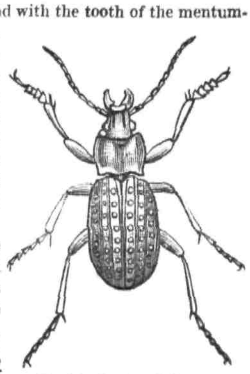
Fig. 54.—Carabus clathratus.

Colosoma, Weber (*Callisthenes*, Fischer), is generally winged; the mandibles are without distinct teeth on the inner edge; the thorax is transverse, equally dilated and rounded at the sides, without elongated posterior angles; the abdomen is nearly square; the four posterior tibiæ are curved in the males of several. The species are fewer than in Carabus, but they extend from the north to the equator. Type, *Carabus sycophanta*, Linn., three-fourths of an inch long, of a velvet black, with the elytra golden green, or brilliant copper, very finely striated, each having three lines of fine impressed dots. Its larva lives in the nests of the processionary Caterpillars, upon which it feeds, devouring many in the course of a day. Other larvæ of its own species, smaller and younger, attack and devour it when its voracity has overcome its activity. They are black; and are sometimes found running on the ground, or upon trees, especially the oak. [An elaborate anatomical memoir upon this larva, by Dr. Hermann Burmeister, is published in the *Transactions of the Entomological Society*, in the last part of which Mr. Hope has also published the descriptions of some species brought home by Mr. Charles Darwin, the celebrated naturalist of the expedition of the Beagle.]

A third and last division of the *Grandipalpi* is at once distinguished from the former by a series of characters. The majority are winged; the basal joints of the fore tarsi of the males are always dilated; the labrum is entire; the outer palpi are very slightly dilated at the tips; the inner edge of the mandibles is not armed with distinct teeth; and the tooth of the mentum-notch is bifid. The fore tibiæ of many species have a short notch at the inner side, where one of the spines is inserted higher than the other: so that these Carabiques, as well as those of the following section, might come immediately after the Patellimani. They generally frequent humid and aquatic places. Some of them, such as Omophron, seem to unite this tribe with the following, or the aquatic carnivorous species.

Some have the eyes of ordinary size, the antennæ linear, with elongated joints, and the two spurs of the fore tibiæ close together,—the tibiæ having only a longitudinal canal.

Pogonophorus, Latr. (*Leistus*, Frœhl., *Manticora*, Panz.), is remarkable for the elongation of the outer palpi, and the labial ones, which are longer than the head; the mandibles are bulged out into a flat angle at the base outside, and the tonguelet is terminated by three spines. Type, *Carabus spinibarbis*, Fabr., [a common British species.]

Nebria, Latr., differs from the preceding in the palpi being much shorter; the outside of the mandibles is scarcely dilated, the tonguelet is short. Type, *Carabus brevicollis*. [One of the most abundant species.]

Alpæus, Bon., are apterous Nebriæ, merely more oblong, and which frequent high mountains. *Carabus Hellwigii*, Panz.

Omophron, Latr. (*Scolytus*, Fabr.), differs from the three preceding in having the body gibbose above, and nearly orbicular; the thorax very short, transverse, and the scutellum is not visible. This subgenus is composed of a small number of species found on the margin of waters in Europe, North America, Egypt, and the Cape of Good Hope. M. Desmarest has described the larva of the common species, [*S. limbatum*, Latr., found on the border of streams in France.] This larva approaches that of the Dytici in its form.

The remainder of this division have the body thick, with large prominent eyes; antennæ rather thickened at the tips, with short joints; one of the spurs of the fore tibiæ is inserted above the other; the four or three basal joints of the anterior tarsi of the males are but slightly dilated in the majority. These insects are found on the banks of rivers in Europe and Siberia.

Blethisa, Bon., has the thorax broader than long, nearly square, being only slightly narrowed near the posterior angles, with the four basal joints of the *Carabus multipunctatus*, Fabr., Panz.

Pelophila, Dej., has the three basal joints of the fore tarsi of the males strongly dilated. *Carabus borealis*, Fabr., [a species recently detected in Ireland].

Elaphrus, Fabr., has the thorax at least as long as it is broad, convex and heart-shaped; the four basal joints of the fore tarsi of the males slightly dilated.

Carabus uliginosus, Fabr., four lines long, has the elytra ornamented with deep circular impressions running into each other, with an elevated disc.

Cicindela riparia, Linn., is another common British species, smaller than the preceding.

Notiophilus, Dum., differs from the preceding in having the labrum nearly semicircular, (instead of short and transverse,) and the outer palpi are terminated by a suboval joint pointed at the tip; the tarsi are alike in both sexes. *Cicindela aquatica*, Linn., [a very common British species found on the banks of streams and in damp situations, running about with very great agility. Mr. Waterhouse has published a monograph on the genus in the *Entomological Magazine*, where he has described eighteen British species; but subsequent Coleopterists have greatly reduced the number of the species.]

Our second general division of this tribe, the *Subulipalpi*, is distinguished by the form of the outer palpi, of which the penultimate joint is in the form of a reversed cone, and is united to the following, with which it forms an oval or spindle-shaped mass, terminated in a point. The two anterior tibiæ are always notched. These insects closely resemble the last, both in their form and habits.

Bembidion, Latr. (*Bembidium*, Gyll.), has the penultimate joint of the outer maxillary palpi swollen, and the last very slender and conical. The basal joint of the two anterior male tarsi is dilated in the males. Messrs. Ziegler and Megerle divided this subgenus into several others, but without giving their characters; founding them, as it seems, entirely on the change of form of the thorax. These are *Tachypus*, *Bembidium*, *Lopha*, *Notaphus*, *Peryphus*, and *Leia*, [the last of which (being previously used for a genus of Diptera) has been changed by Stephens into *Philochthus*.] The type given by Latreille (considered by Dejean as a Tachypus) is the *Cicindela flavipes*, Linn., one-fifth of a line long, a very abundant species. [This genus comprises a considerable number of species, all of which are of very small size, being the most minute of all the Carabiques, and generally of brassy or coppery tints. Another pretty species is the *Cicindela quadri-maculata*, Linn.; of a brassy colour, with four white spots on the elytra.]

Trechus, Clairv., has the last joint and the outer palpi as long or longer than the preceding, and as thick at its base, so that together they form a fusiform mass. *Trechus rubens*, Clairv., *masoreus*, Zeigl., is allied to Trechus, with palpi fusiform at the tip, but with the penultimate joint shorter than the following; the fore tarsi of the males is slightly dilated. *Harpaleis collares*, Gyll., *Blamus*, Zeigl., is composed of narrowed Trechi with the thorax of a reversed-triangular form, and mandibles proportionably larger, and extending beyond the labrum.

[In terminating the terrestrial carnivorous Beetles, it is necessary again to refer to the many works recently published, containing either isolated descriptions or more complete monographs of these insects. Dejean, Klug, Hope, Kirby, Gory, Laporte, Brullé, Erichson, Mannerheim, and many other recent Entomologists have devoted their attention to this tribe, many seeming to prefer them from the circumstance of their standing at the head of the order. Some of them have cut up the several groups given by Latreille into a great number of smaller groups, for which they have retained the family names terminating in *idæ*. It is of course impossible to give any synopsis, or even notice, of the many generic or subgeneric groups which have been proposed, chiefly founded upon exotic insects, of which nothing is known except their existence as cabinet specimens.]

The aquatic, carnivorous, pentamerous Coleoptera, form a third tribe, that of

THE HYDROCANTHARI, or *Swimmers.*

Their feet are formed for swimming, the four posterior being compressed and ciliated, or in the form of plates, and the two hind ones are far apart from the others. The mandibles are nearly covered [by the upper lip], the body is always oval, with the eyes slightly prominent, and the thorax much broader than long; the hook which terminates the maxillæ is curved from the base; the ungues are often unequal.

These insects compose the genera *Dytiscus* and *Gyrinus* of Geoffroy. They pass the first and the last state of their existence in fresh water, such as lakes, pools, and ditches. They swim well, and rise to the surface of the water from time to time to respire, ascending easily by holding their feet still and suffering themselves to float. The body being turned upside down, they slightly elevate the tip of the body above the surface of the water, raising the extremity of the elytra or bending down the abdomen, so that the air introduces itself into the spiracles, which they cover, and from thence into the tracheæ. They are very voracious, and feed upon small animals which, like themselves, ordinarily reside in the water, which the Hydrocanthari only leave at the approach of or during the night. When taken out of the water they emit a very disagreeable odour. They are sometimes attracted by the light into the interior of houses. Their larvæ have the body long and narrow, composed of twelve segments, of which the first is largest, with the head strong, and armed with two powerful mandibles, which are curved into an arch and pierced near the tips; they have also short antennæ, palpi, and six simple eyelets close together on each side of the head. They have six feet of moderate length, often fringed with hairs, and terminated by two small hooks. They are active, carnivorous, and respire either by the anus, or by a kind of swimmerets resembling gills. They quit the water in order to undergo their metamorphosis into pupæ.

This tribe is composed of two principal genera.

DYTISCUS, Geoff.,*—

Which have thread-like antennæ longer than the head, two eyes, the fore legs shorter than the following, and the posterior often terminated by a compressed tarsus finishing in a point. They swim with great quickness by the assistance of their feet, fringed with long hairs, especially the posterior pair. They dart forward upon other insects, aquatic worms, &c. In the majority of the males the four anterior tarsi have the three basal joints dilated and spongy beneath; those of the first pair are especially remarkable in the large species, in which these three joints form a broad plate, the under surface of which is covered with small bodies, some of them like warts and others like small suckers. Some females are distinguished by their elytra being furrowed. The larvæ have the body composed of eleven or twelve segments covered by scaly plates; they are long, swollen in the middle, and slenderer at each end, especially when the terminal segments form an elongated cone fringed at the sides with floating hairs, with which the animal beats the water and thus propels the body forwards, which is ordinarily terminated by two conical bearded and moveable filaments, between which are two small cylindrical bodies pierced with a gutter, at the extremity which are aerial channels, to which are attached two tracheæ; moreover, the sides of the body are provided with spiracles: the head is large, oval, attached to the thorax by a neck with strongly-armed mandibles, beneath the extremity of which De Geer observed a longitudinal slit, so that these organs resemble the mandibles of the larvæ of the Myrmeleons, or Ant-lions, and serve them for suckers: the mouth offers besides a pair of maxillæ and a lip with palpi: each of the three first segments supports a pair of moderately long legs, of which the tibia and tarsus are fringed with hairs, which are serviceable in swimming; the first segment is the broadest or longest, and defended beneath, as well as above, by a scaly plate.

These larvæ suspend themselves at the surface of the water by means of two appendages at the sides of the tail, which they keep dry by raising them above the surface. When they wish to change their place suddenly, they give their body a quick and vermicular movement, beating the water with the tail. They especially feed upon the larvæ of Dragon-flies, Gnats, Tipulæ, Aselli, &c. When the period of their transformation has arrived, they quit the water and bury themselves under the earth of the adjacent banks, keeping, however, in very damp situations, where they form an oval cavity in which they

* [Latreille is incorrect in giving *Geoffroy* as the author of the name Dytiscus, it having been proposed by Linnæus. Geoffroy, on the contrary, corrected it to *Dyticus*, being derived from the Greek *Deutikos*, urinatorius.]

inclose themselves. According to Rœsel, the eggs of the *Dytiscus marginalis* hatch ten or twelve days after being deposited: at the end of four or five more, the larva is already four or five lines long, and moults for the first time. The second change of skin takes place at the expiration of a similar interval, and the animal is now as large again as it was before: when full grown it is two inches long. In summer it has been observed to become a pupa at the end of fifteen days, and a perfect insect in fifteen or twenty more days.

This great genus is divisible as follows:—

The majority have the antennæ composed of eleven distinct joints; the outer palpi filiform, or slightly thickened at the tips, and the base of the hind-legs exposed.

Dytiscus, has all the tarsi composed of five distinct joints; the three basal joints of the fore-legs being very large, and forming an oval or orbicular plate. Type, *D. marginalis*, Linn., a very common British species, an inch and a quarter long, being of a dark olive colour with a buff-coloured margin entirely round the thorax, and a line of the same colour on the outer margin of the elytra, which are not dilated at the sides; those of the female are furrowed from the base about two thirds of the whole length. Fabricius says, that the species when laid upon its back gains its ordinary position by taking a leap. Esper kept a specimen of this insect for three years and a half in good health in a large bottle of water, feeding it every week and sometimes oftener with bits of raw beef about the size of a nut, upon which it precipitated itself and sucked the blood entirely from it. It was able to fast for a month at a time. It killed a specimen of *Hydrophilus piceus*, although as large again as itself, by piercing it between the head and thorax, the only part of the body without defence. According to Esper, it is sensible to the changes of the atmosphere, which it indicates by the heights at which it keeps in the bottle.

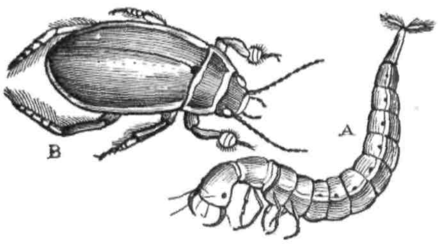

Fig. 55.—Dytiscus marginalis and its larva.

Dytiscus Rœselii, Fab., [the type of Curtis's genus *Cybister*, or *Trogus* of Leach], is much more depressed than the preceding, and has the outer margin of the thorax and elytra yellowish; these elytra are finely striated in the female; the hind legs have the tibiæ very short and broad. It is found in the neighbourhood of Paris and in Germany, but is extremely rare in England.

Dytiscus serricornis, Paykull, is very remarkable for the antennæ of the male having the four terminal joints forming a compressed and toothed mass, whence Dr. Leach formed it into his genus *Agabus*; other characters, such as the form and relative proportions of the joints of the outer maxillary palpi, have also led him to form other genera, namely—*Hydaticus* (*Dyt. Hybneri, transversalis*, &c.) and *Acilius* (*D. sulcatus*). [These various groups, here reduced by Latreille to the subgenus Dytiscus, are far better marked than many of the groups admitted amongst the Carabiques possessing characters, not only in the imago, but also in the larva states, amply sufficient to warrant their separation.]

Colymbetes, Claiv., has all the tarsi distinctly 5-jointed, but the four anterior tarsi in the males are equally dilated into one small oblong plate, and the antennæ are at least as long as the head and thorax; the body is perfectly oval, and broader than deep, and the eyes are not exposed. Types, *Dyt. fuscus*, Panz., *D. cinereus*, Fabr., Panz., &c. [These insects are of an intermediate size between the foregoing and following species, and form a very extensive group. Erichson, Eschscholtz, and Aubé, have particularly studied this group, and have proposed various dismemberments from it, which have been partially adopted by more recent authors.] Some of the smaller species without a visible scutellum, and with the anterior tarsi scarcely dilated in the males, compose Leach's genus *Laccophilus*; such are the *D. hyalinus*, Marsh., *D. minutus*, Linn., &c.

Hygrobia, Latr. (*Hydrachna*, Fabr., *Pœlobius*, Schonh.), have the four anterior tarsi in the males also equally dilated into a small oblong plate, but the antennæ are shorter than the head and thorax; the body is ovoid, very thick in the middle, and the eyes very prominent. Type, *H. Hermanni*, Latr., [a common British species].

Hydroporus, Clairv., has the four anterior tarsi spongy beneath in both sexes, with only four distinct joints, the ordinary fourth joint being obsolete or very small, and hidden, as well as the base of the following, in a deep notch of the third. The scutellum is not visible. The body is oval. Types, *Dytiscus inequalis, picipes*, &c.

Hyphydrus, Latr., consists of such species of the latter as have the body nearly globular, and the last joint of the four anterior tarsi is very small, and scarcely extending beyond the preceding. *H. gibba, ovalis, scripta*, Fabr.

Noterus, Clairv., differs from all the preceding by having the antennæ dilated in the middle, and the last joint of the labial palpi is notched, so as to appear forked. *Dytiscus crassicornis*, Fabr.

Haliplus, Latr., (*Hoplitus*, Clairv., *Cnemidotus*, Illig.) forms a distinct section having only two distinct joints in the antennæ; the palpi terminated by a small joint pointed at the tip, and the base of the hind legs covered by a large plate. Types, *Dytiscus fulvus, impressus, obliquus*, and many other species of very small size.

[The family Dyticidæ of English authors has been investigated by several recent authors, especially by Leach, in the *Zool. Miscell.*, vol. iii.; Erichson, in his *Genera Dyticeorum*, and *Kafer der Mark Brandenburg;* Laporte in the *Etudes Entomologiques;* Say in the *American Phil. Trans.*

new. ser. vol. ii. and iv.; and still more recently by M. Aubé in his continuation of the *Spécies généra. des Coléopterès* of Dejean, and in the *Coléoptères d'Europe*. In the former of these two works, pub lished in 1838, he divides the Hydrocanthari into three groups, *Haliplides*, *Dytiscides*, and *Hydroplorides;* the first comprises two genera, *Haliplus*, 20 sp.; and *Cnemidotus*, 3 sp.: the Dytiscides are divided into *Pœlobius*, 1 sp.; *Cybister*, 36 sp.; *Dytiscus*, 17 sp.; *Eunectes*, 1 sp.; *Acilius*, 17 sp.; *Hydaticus* (in four sections), 44 sp.; *Colymbetes*, 39 sp.; *Ilybius*, 11 sp.; *Agabus*, 60 sp.; *Copelatus*, 17 sp.; *Matus*, 1 sp.; *Coptotoma*, 1 sp.; *Anisomera*, 1 sp.; *Noterus*, 3 sp.; *Hydrocanthus*, 7 sp.; *Suphis*, 1 sp.; *Laccophilus*, 22 sp.; and the Hydroporides comprise the genera *Celina*, 3 sp.; *Vatellus*, 1 sp.; *Hyphydrus*, 11 sp.; and *Hydroporus*, 122 sp. Besides these, Mr. Babington has read the descriptions of the species brought home by Mr. C. Darwin in a paper before the Entomological Society of London.]

The second principal genus, that of

GYRINUS, Linn.,—

Comprises those which have the antennæ in a mass, and shorter than the head; the two fore-legs are long, advanced like arms, and the four others very short and depressed, broader and oar-like. The eyes are four in number, the body is oval, and generally very shining; the antennæ, inserted in a cavity before the eyes, have the second joint exteriorly elongated like an ear, and the following joints (of which seven are only distinctly visible) very short, and closely united into a mass nearly like a spindle, and rather bent; the head is inserted into the thorax as far as the eyes, which are large, and divided by a ridge on the sides, so that there appear two above and two below; the upper lip is rounded, and very much ciliated in front; the palpi are very small, and the inner pair of the maxillary are wanting in many species, especially the large exotic ones. The thorax is short and transverse, the elytra are obtuse or truncated at the posterior extremity, leaving the anus exposed, which is terminated by a point. The two fore-legs are slender, long, folded up, and held nearly at right angles with the body when shut up, and terminated by a very short compressed tarsus, of which the under-side is clothed with fine plush in the males. The four other feet are broad, very thin like membrane, and the joints of the tarsi form small leaves.

These insects [which are called Whirlwigs, from their peculiar motions] are in general of small or but moderate size. They are to be seen, from the first fine days of spring till the end of the autumn, on the surface of quiet waters, and even upon that of the sea, often assembled in great numbers, and appearing like brilliant points. They swim or run about with extreme agility, curvetting in a circular or oblique, or indeed in every direction: whence their ordinary French name of Tourniquets, or their English name given above. Sometimes they remain stationary without the slightest motion; but no sooner are they approached than they escape by darting under the surface of the water, and swimming off with the greatest agility. The four hind-legs are used as oars, and the fore ones for seizing the prey. Ordinarily stationed upon the surface of the water, the upper side of the body is always dry; and when they dart down, a bubble of air like a silvery ball remains attached to the hind part of the body. When seized, they discharge a milky fluid, which spreads over the body, and probably produces the disagreeable odour which they then emit, and which lasts a long time upon the fingers. Sometimes they remain at the bottom, holding upon plants, where also they possibly hide themselves through the winter.

Fig. 56.—Gyrinus natator.

Gyrinus natator, Linn., is three lines long, oval, very smooth and shining, of a bronzed black colour above, black beneath, with the legs fulvous; scutellum triangular, and very pointed; elytra with small impressed dots in regular longitudinal lines. The larva is long and linear, 13-jointed, each of the first three segments supporting a pair of feet; the fourth and following segments have on each side a conical membranous filament, flexible, and bearded at the sides; the twelfth segment has four, but they are longer, and bent backwards. This larva lives in the water, coming forth at the beginning of August to undergo its changes. It forms a cocoon of an oval form pointed at each end, which it affixes to rushes. This is a very abundant species [throughout Europe.]

[Messrs. Laporte, Brullé, and Aubé, have especially studied this family, and have proposed several additional genera. The last of these authors, in his *Spécies Général* above mentioned, has described the following genera: namely,—*Enhydrus* with three species, *Gyrinus* with forty-five, *Patrus* with one, *Orectochilus* with fourteen, *Gyretes* with eight, *Porrorhynchus* with one, and *Dineutes* with twenty-one.]

THE SECOND FAMILY OF THE COLEOPTERA PENTAMERA,—

BRACHELYTRA, Cuv. (*Microptera*, Grav.),—

Have only one palpus to each maxilla, or four in all, [two maxillary; the outer lobe of the maxillæ not being palpiform, as in the foregoing tribes, and two labial]; the antennæ, either of equal thickness throughout, or a little thickened at the tip, are generally composed of oval or lenticular joints; the elytra are very much shorter than the body, which is narrow and elongated, with the coxæ of the fore-legs very large, and two vesicles near the anus, which the insect protrudes at will.

These Coleoptera compose the genus

STAPHYLINUS, Linn.,—

Which have been regarded as forming the passage from the Beetles to the Earwigs, the first genus in the following order. In some respects, they approach the insects of the preceding family, and in many others, the Silphæ, &c., belonging to the fourth family. They have in general the head large and flat, strong mandibles, antennæ short, the thorax as broad as the abdomen, the elytra truncate at the tip but still covering the wings, which are of the ordinary size; the dorsal semi-segments of the abdomen are as scaly as the ventral ones; from the anal vesicles a subtle vapour is discharged, which in some species smells very strongly of sulphuric ether. M. L. Dufour (*Ann. Sci. Nat.*, vol. viii. p. 16.), has described the apparatus by which it is secreted.

These Beetles [one of the largest of which is well known under the name of the Devil's Coach-horse], when touched turn up the end of the body, bending it in all directions; they also use it for the purpose of assisting in folding up their wings under the short elytra. The tarsi of the fore-feet are often broad and dilated, and the coxæ of the four fore-legs are very broad. The majority live in the earth, on manure and excrement; others are found in boleti, rotten wood, under stones; and others only are met with near water; some again, of small size, are only found in flowers. All are very voracious, run with great quickness, and take flight with ease.

Their larvæ greatly resemble the perfect insects, being of an elongated conical form, of which the base, or the widest part, is occupied by the head, which is very large; the terminal segment of the body is prolonged into a tube, and accompanied by two conical hirsute appendages. These larvæ feed upon the same substances as the perfect insects.

The genus being very numerous, we divide it into five sections,

The first section, that of the *Fissilabra*, has the head entirely exposed and separated from the thorax, (which is sometimes square or semi-oval, and sometimes rounded, or in the shape of a reversed truncated heart)by a neck or evidently narrowed part. The upper lip is deeply slit, and divided into two lobes.

Oxyporus, Fab., has the maxillary palpi filiform, and the labial terminated by a large crescent-shaped joint; antennæ short and compressed, and fore-tarsi not dilated. Type, *Staph. rufus*, Linn., about one-third of an inch long, varied with red and black; [a not uncommon British species.]

Astrapæus, Grav., has all the palpi terminated by a large, nearly triangular joint, and fore-tarsi much dilated. *Staph. ulmi*, Clairv.

Staphylinus, Fabr., has all the palpi filiform, and the antennæ inserted between the eyes. Some of these, especially the males, have the fore-tarsi very much dilated, the antennæ wide apart at the base, the basal joint not exceeding one fourth of their entire length, and the head slightly elongated; these compose the restricted genus *Staphylinus* of some systems. Another species, *S. dilatatus*, Fabr., has been separated on account of its dilated serrated antennæ, to form another [*Velleius*, Leach]. According to M. Chevrolat, this species feeds upon caterpillars, which it seeks upon trees. [It is now known to feed in Hornets' nests.]

[This genus, *Staphylinus* as here restricted, is very numerous, and has been divided by Kirby, Leach, Stephens, and others, into several genera, such as *Emus*, *Creophilus*, *Goerius*, *Ocypus*, *Philonthus*, *Gabrius*, &c.]

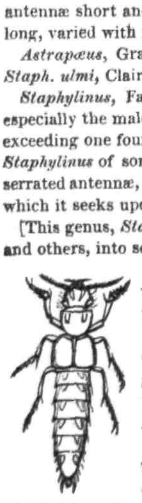

Fig. 57.—Staphylinus erythropterus.

Staphylinus erythropterus, Linn., is from two-thirds to one inch long, of a velvety black colour, with the elytra, base of the antennæ, and feet fulvous, [and with golden hairs on the side of the thorax and abdomen. It is very abundant in the spring.]

The others are of a more linear form, with the head and thorax elongate-quadrate; the antennæ close at the base, strongly elbowed; and the fore-tarsi but slightly dilated. These form the genus *Xantholinus*, *Stap. fulgens*, &c.

Pinophilus, has filiform palpi, and the antennæ inserted behind the eyes. *P. latipes*, North America.

Lathrobium, Grav., has the palpi terminated suddenly by a minute pointed joint, often indistinct; the antennæ are inserted before the eyes; the fore-tarsi are dilated in both sexes. *Staph. elongatus*, Linn.

The second section, *Longipalpi*, has, also, the head entirely exposed, but the labrum

is entire, and the maxillary palpi are almost as long as the head, terminated in a mass formed of the third joint, the fourth being concealed or very indistinct, and forming a small point terminating this mass, when present, the preceding being very much swollen. These insects live upon the margins of water.

Pæderus, Fabr., has the antennæ inserted before the eyes, filiform, or gradually increasing in size, and longer than the head; body long and narrow; and mandibles toothed and pointed at the tip, with the penultimate joint of the tarsi bifid. Type, *Staph. riparius*, Linn., [a pretty little common British species].

Stilicus, differs in having all the joints of the tarsi entire.

Procirrus, Latr., has the last joint of the maxillary palpi distinct, and forming a terminal mass; the head is attached by a long peduncle; thorax long and narrow; and the fore tarsi dilated. *P. Lefeburi*, Latr., Sicily.

Evesthetus, Grav., has the antennæ inserted before the eyes, but not longer than the head, and moniliform; body slightly elongated. *E. scaber*, Grav.

Stenus, Latr., has the antennæ inserted near the inner margin of the eyes, and terminated by a mass formed of the last three joints; the eyes are large, and the mandibles furcate. *Staph. biguttatus*, Linn.; black, with a red dot on each elytron; [very common.]

The third section, *Denticrura*, differs from the preceding in having the maxillary palpi much shorter than the head, with four distinct joints; the tibiæ at least of the fore-legs are toothed or spined; the tarsi fold back on the tibiæ, and have the last joint as long as all the preceding together, some of which are more or less obsolete. The front of the head is cornuted in the males of some species.

Oxytelus, Grav., differs from all the rest in having the palpi terminated by a hatchet-shaped joint, the antennæ moniliform and gradually thickened, with only three distinct joints to the tarsi. [A very numerous genus.]

Osorius, Leach, has the palpi filiform, the body cylindric, and the mandibles much shorter than the head. The species are from South America.

Zirophorus, Dalm. (*Irenæus*, Leach; *Piestus*, Grav.), has the body depressed, the fore tibiæ alone toothed on the outside, the antennæ at least as long as the head and thorax, and mandibles as long as the head. (See Dalman's *Anal. Entomol.*, p. 23.)

[*Leptochirus*, Germar, differs from the last in the antennæ being very short. The species of both are tropical.]

Prognatha, Latr. (*Siagonium*, Kirby) [not *Siagona*], differs from Zirophorus in the antennæ being filiform, and composed of elongated joints. [*S. quadricorne*, Kirby: a rare British species.]

Coprophilus, Latr. [*Elonium*, Leach], has the body flattened, but all the tibiæ are toothed on the outside; the antennæ much longer than the head, and the mandibles not toothed. *Omalium rugosum*, Grav.

The fourth section, *Depressa*, has the head free, the labium entire, and the maxillary palpi short, with four distinct joints; but the tibiæ are simple, without teeth or spines, and the tarsi distinctly 5-jointed.

Omalium, Grav. (having the thorax as broad as the elytra, and transverse-quadrate), *Lesteva*, Latr. (*Anthophagus*, Grav., having the thorax narrower than the elytra, and in the form of a truncated heart), have the palpi filiform, but the following have them hatchet-shaped:—

Micropeplus, Latr., has the antennæ terminated by a solid club, and received into channels of the thorax. *M. porcatus*, [a minute British species].

Proteinus, Latr., has the antennæ perfoliated, and thickened towards the tip, but free, and inserted before the eyes. [*P. ovalis*, a common insect found in moss.]

Aleochara, Grav., has the antennæ inserted between the eyes, or near their lower edge, and free; the thorax is nearly oval, or square, with the angles rounded. [A very extensive group of insects, now cut up into a great number of genera and subgenera by Stephens, Erichson, and others.]

The fifth section, *Microcephala*, has the head received into the thorax as far as the eyes, not being attached by a neck, nor an evident narrowed space; the thorax is trapeziform, and enlarged from the front to the hind part; the body is less elongated than in the preceding, and approaches more an elliptical form; the head is much narrower, and sharpened in front; the mandibles of moderate size, without teeth, and simply curved to the point; the elytra, in many, cover more than the half of the abdomen. Some of the species live in fungi, or upon flowers, and others in dung.

Lomechusa, Grav., has no spines to the tibiæ; and the antennæ (often shorter than the head and thorax), after the fourth joint form a perfoliated mass; and the palpi are terminated by a hatchet-shaped joint: some have the sides of the thorax not raised. *Aleochara bipunctata*, Grav., &c.; and the others have them elevated: these form Gravenhorst's genus *Lomechusa; L. paradoxa*, &c.

Tachinus, has the tibiæ spiny, the joints of the antennæ are pear-shaped, and the palpi filiform. Type, *Oxyporus subterraneus*, and many other *Oxypori*, Fabr.

Tachyporus, Grav., is like Tachinus in the tibiæ and antennæ, but the palpi are terminated by a hatchet-shaped joint. *Oxyporus rufipes*, Fabr., *Chrysomelinus*, Fabr., and a great many others.

Callicerus, Grav., stated by Latreille to be unknown to him, [is oblong depressed; with the last joint of the antennæ disproportionately long; the third joint of the maxillary palpi swollen; and the last minute. Type, *S. Spencii*, K. Curtis, *Brit. Ent.*, pl. 443.]

Stenosthetus, Meg., and Dej. Cat., must be suppressed, being a true Pselaphus, [or rather an Euplectus].

[The Brachelytra have been investigated by several recent authors, who have published either complete monographs, or descriptions of the species belonging to various countries. In addition to Paykull's monograph of the Swedish species, published in 1789, and Gravenhorst's *Coleoptera Microptera*, at Brunswick in 1802, and *Monogr. Coleopt. Micropt.*, 1806, we may mention Count Mannerheim's revision of the tribe, published in the *Transactions of the Imperial Acad. St. Petersburg*, 1831; Latreille's memoir on the Denticrura, in the *Nouv. Annales du Museum*, vol. i.; Laporte's descriptions of many new species in his *Etudes Entomologiques*; Nordmann's work on the Brachelytra, published at Berlin in 1838; Erichson's description of the Coleoptera of Brandenburg, and his *Genera et species Staphylinorum*, just published, (December 1839); and Mr. Stephens's *British Entomology*; in all which works, as well as in numerous detached memoirs by other authors, to which we cannot refer in detail, are contained the descriptions of numerous new species and many new genera,—to speak according to the text of *this work*, subgenera,—amongst which some remarkable variations of structure occur, especially in some just figured by Erichson, and *Diglossa*, Hal., and *Centroglossa* and *Deinopsis*, Mathews, described in the *Entomological Magazine*. We have collected all that relates to the natural history of these insects in the *Introduction to the Modern Classification of Insects*, vol. i. p. 162. The family Pselaphidæ, placed in this work at the end of the Beetles, ought in a natural system to be placed in immediate contact with the Brachelytra.] *

THE THIRD FAMILY OF THE COLEOPTERA PENTAMERA,—

THE SERRICORNES,—

Also possesses only four palpi, but the elytra entirely cover the abdomen, which, with other characters, distinguishes them from the Brachelytra; the antennæ (with some exceptions,) are of the same thickness throughout, or slender at the tip, and toothed, serrated, or fan-shaped; being most developed in these respects in the males. The penultimate joint of the tarsi is often bilobed or bifid. These characters are rarely found in the next family, the Clavicornes, to which we approach so gradually that it is difficult to assign its limits rigorously.

Some of the Serricornes, having the body always of a solid consistence, and often oval or elliptic, with the feet partly contractile, have the head vertically introduced as far as the eyes into the thorax, and the prosternum, or the middle part of this portion of the body, elongated, dilated, or advanced in front as far as the mouth, (generally distinguished on each side by a canal, in which the antennæ, always short, repose,) and posteriorly prolonged into a point which is received in an impression of the anterior extremity of the mesosternum. These fore-legs are at a distance from the anterior extremity of the thorax. These Serricornes form a first section, that of the *Sternoxi*.

Others, having the head also received posteriorly into the thorax, or at least covered by it at the base, but of which the prosternum is not dilated and advanced anteriorly like a necklock, nor ordinarily terminated (except in Cebrio) behind in a point received into a cavity of the mesosternum, and in which the body is generally entirely or partly of a soft and flexible consistence, compose the second section, *Malacodermi*.

A third and last section, the *Xylotrogi*, comprises those Serricornes in which the prosternum is not elongated at its posterior extremity, and in which the head is entirely free, and separated from the thorax by a narrowed neck.

We divide the first of these sections, the *Sternoxi*, into two tribes.

The first, *Buprestides*, has the posteriorly produced part of the prosternum flat, not terminated by a laterally compressed point, and simply received in a depression or notch of the mesosternum. The mandibles are often terminated in an entire point without a notch; the posterior angles of the thorax are not, or but slightly, elongated; the last joint of the palpi is generally cylindric, and not thicker than the preceding; the majority have the tarsi dilated and cushioned beneath. They do not leap, which eminently distinguishes them from the following tribe. They compose the genus

BUPRESTIS, Linn.,—

And have been termed *Richards* by the French, in allusion to their splendid colours, many being

* The Silphæ, in respect to their internal structure, ought, in conjunction with the other clavicorn Beetles, immediately to follow Brachelytra.

remarkable for the spots of gold colour on an emerald ground; in others, azure glitters upon the gold, or various other metallic colours are exhibited. The body is in general oval, broad and obtuse, but narrowed from the base to the tips of the elytra; the thorax is broad and short; the scutellum small or wanting; the elytra often toothed at the tips, and the legs short. They creep slowly, but their flight is very active in hot weather; when attempted to be seized they fall to the ground. The females have at the extremity of the body a corneous or leathery conical plate, composed of the last three joints, which is probably the instrument with which they deposit their eggs in dry wood, upon which the larvæ feed; the small species are found upon leaves or flowers, but others are only found in forests or timber yards; they sometimes make their appearance in houses, having been introduced into the wood whilst in the larva or pupa state.

Buprestis, has the antennæ of equal thickness throughout, and serrated from the third or fourth joint; some of the species [which are extremely numerous, of large or moderate size, and chiefly extra-European,] have no [visible] scutellum. Such are *B. fasciculata*, Linn., from the Cape of Good Hope, remarkable for the bundles of hair with which it is clothed; *B. sternicornis*, Linn., from the East Indies, having the mesosternum produced into a long porrected horn; *B. vittata* and *ocellata*, splendid Indian and Chinese species. The other species have a [distinct visible] scutellum; such are *B. gigas*, Linn., from Cayenne, two inches long; and *B. viridis*, Linn., [belonging to the subgenus *Agrilus*,] a small English species, about a quarter of an inch long, and of a green colour. Found upon trees.

Trachys, Fab., has the body short and broad, or almost triangular; the front excavated; and the thorax lobed behind. *B. minuta*, Linn., [a very minute, and not uncommon British species].

Aphanisticus, Latr., has the antennæ terminated by an oblong, compressed, sudden mass, formed of the last four joints; the forehead is deeply notched. They are of minute size, and of a linear form. *Bupr. emarginata*, Fabr., [a rare British insect].

Melasis, Oliv., differs from all the rest in the antennæ being strongly pectinated in the males and serrated in the females; the tarsal joints are cylindrical and entire. *M. Buprestoides*, Oliv., [a very local British species, and found in Windsor and the New Forests].

[The *Buprestidæ*, notwithstanding the splendour of their colours,] have attracted, until lately, but very little attention as respects their structural classification. Schonherr, and more recently Eschscholtz, in the *Zoological Atlas*, in which fifteen genera are described; Solier, who has divided the species into thirty-four genera in the *Annals of the French Entomological Society*, 1833; Gory and Laporte, in their beautiful *Histoire Naturelle et Iconographique des Insectes Coleoptères*, in which they are describing and figuring all the species of this brilliant family; Laporte, in *Silbermanns Revue Entomologique;* Count Mannerheim, in a memoir published in the *Bulletin Soc. Imperiale des Naturalistes de Moscou*, and several other modern authors, have investigated this beautiful but difficult tribe. The larvæ have also been recently observed by Messrs. Audouin, Aubé, and Dr. Ratzeburg, [see my *Introduc. to Mod. Classific.*, vol. i. p. 230, 231]; they are of a flattened form, and are distinguished by their large, flat head.

The second tribe, that of the *Elaterides*, differs essentially from the preceding only in having the posterior produced part of the prosternum laterally compressed, and often slightly curved and unidentate, and capable of being lodged at the will of the animal in a cavity of the breast, situated immediately above the place of insertion of the second pair of feet, whereby these insects, when placed upon their back, possess the power of leaping; their mandibles are generally notched at the tip; the palpi terminated by a joint, much longer than the preceding, and of a hatchet-shape; and the joints of the tarsi are entire. This tribe comprises only the genus

ELATER, Linn.,—

Which has the body generally narrow and more elongate than in *Buprestis*, and the posterior angles of the thorax are prolonged into an acute point. They are called Skip-jacks; in Latin *Notopoda* and *Elater;* and when laid upon their backs, being unable to raise themselves in consequence of the shortness of their feet, they spring perpendicularly into the air, so as to fall upon their feet; this is effected by folding the legs close against the body, depressing the head and thorax, and then suddenly bringing the point of the prosternum against the sides of the impression of the mesosternum with a jerk; the body being thus violently brought against the plane of position, is by its elasticity elevated into the air. The sides of the prosternum have a canal, in which the insects conceal their antennæ either partially or entirely; these organs are pectinated or ramose in some males. The females have at the extremity of the body an elongated ovipositor, formed of two lateral pointed pieces, between which is the true oviduct.

These insects are found upon flowers and plants, or on the ground; they depress the head whilst creeping along, and fall to the ground when alarmed, applying the feet to the outside of the body, [which has particular impressions for their reception].

De Geer describes the larva of one of the species, *E. undulatus*: it is long, nearly cylindrical; furnished with short antennæ, palpi, six feet, twelve scaly segments, the last of which forms a flattened rounded plate, angular at the sides, with two recurved points at the end; beneath is a large fleshy retractile lobe, which performs the office of a foot. It lives in soft rotten wood and in the ground. It appears, also, that the larva of *E. striatus*, Fab., devours the roots of corn, and often does much injury where it propagates extensively. [The Wire-worm, so well and objectionably known to the English farmer, is the larva of one of the commonest of our species, *Elater* (*Cataphagus*) *sputator*, which is probably but a variety of the *E. lineatus*, mentioned above; this larva is much more slender than that described by De Geer, and has the terminal segment of the body entire and long, (resembling, in fact, a bit of wire,) with two dark points at the base above.]

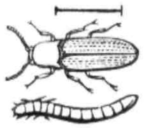

Fig. 58.—Elater sputator and its larva.

We may refer the different subgenera which have been formed in this tribe to two principal divisions; those in which the antennæ are entirely lodged in the canals on the under-side of the prothorax compose the first.

Galba, Latr., (having the mandibles terminated in a simple point), and

Eucnemis, Arh., (in which they are bifid at the tip), have the antennæ received on each side of the prosternum in a longitudinal canal close to the lateral margins of the thorax, and the basal joints of the tarsi are always without elongated lobes beneath. (See the monograph of the last genus, by Count Mannerheim.)

Adelocera, Latr., has filiform antennæ; the tarsal joints have no elongated lobes, and the two fore-legs are lodged in repose in lateral impressions on the under-side of the thorax. *Elater ovalis*, and others from East India.

Lissomus, Dalm. (*Lissodes*, Latr., *Drapetes*, Meg.), has also the antennæ of equal size throughout; tarsal joints entire, but with the lobes on their under edges advanced like small plates; the head is exposed. See Dalman, *Ephem. Ent.*

Chelonarium, Fab., has the seven terminal joints of the antennæ minute, and the body ovoid. [Exotic insects of small size.]

Throscus, Latr. (*Trixagus*, Kug.), has the antennæ terminated by a three-jointed mass, and lodged in a cavity on the under-side of the thorax; the penultimate joint of the tarsi is bifid, and the mandibles are entire at the tip. Type, *Elater dermestoides*, Linn., *Dermestes adstrictor*, Fab. [a rare British insect, of minute size and dull brown colour, but especially interesting on account of its relations, being considered by some authors as allied to the Dermestidæ from the structure of its antennæ. Its larva, according to Latreille, feeds upon the wood of the oak].

Our second division of this tribe comprises those species which have the antennæ always free.

Cerophytum, Latr., has the four basal joints of the tarsi short and triangular, and the penultimate joint bifid: the antennæ of the males are branched.

All the other genera have the joints of the tarsi cylindrical and entire.

Cryptostoma, Dej., has the inner terminal angle of the third and seven following joints of the antennæ, prolonged into a tooth with a straight branch at the base of the third joint. *Elater denticornis*, Fab., Cayenne.

Nematodes, Latr., has the body nearly linear, and the antennæ have the second and four following joints reverse-conic, and the five terminal joints thicker and nearly perfoliated. *Eucnemis filum*, Mann.

Hemirhipus, Latr., has the male antennæ terminated like a fan. These are exotic [and of large size]. *Elater flabellicornis*, Fabr.

Ctenicerus, Latr., has the male antennæ pectinated throughout their whole length. *Elater pectinicornis*, Latr., [a common British species].

Elater proper, has the male antennæ simply serrated. *Elater noctilucus*, Linn., South America,—about an inch long; of a dark brown colour, with two pale dots on the thorax, which emit a very strong light during the night, sufficient to enable a person to read the smallest writing, especially when several of the insects are placed together. The Indian women ornament their head-dresses with these insects. Brown asserts that all the inner parts of the insect are luminous, and that it can suspend its light at will; but M. Lacordaire informs me that the principal reservoir of the phosphorescent matter is situated on the under-side, at the junction of the abdomen with the thorax. One of these insects, which had been carried in wood to Paris, in the larva state, caused great alarm to the inhabitants of the Faubourg St. Antoine, who were ignorant of the cause of the light.

Campylus, Fischer, *Exopthalmus*, Latr., differs from all the preceding in having the head free, and the eyes large and globular; the body is long and linear. *Elater linearis*, Linn.

Phyllocerus, Latr., is distinguished by having the palpi filiform [not clavate], and antennæ pectinated after the fourth joint. [*P. flavipennis*, south of Europe, figured by Guérin in his *Iconographie*.]

[The family Elateridæ, on account of the general uniformity of their appearance and dullness of their colours have only recently any attention in respect to their structural distribution into genera and subgenera. Dr. Eschscholtz, however, in the second volume of *Thon's Entomologische Archiv.*; Latreille, in the *Annals of the Entomological Society of France for* 1834, and still more recently, Dr. Germar, in the second number of his

Zeitschrift fur die Entomologie, have minutely investigated their structure, and have proposed a great number of groups in addition to those given in the text, often, it is true, resting upon very minute and obscure characters.]

Our second section, *Malacodermi*, is divisible into five tribes.

The first, *Cebrionites*, so named from the genus *Cebrio*, Oliv., to which some others are added, has the mandibles terminated in a single point; the palpi of equal thickness throughout, or slender at the tip; the body rounded and swollen in some; oval or oblong, but arched above and bent down in front, in others. It is often soft and flexible, with the thorax transverse, broadest at the base, with the lateral angles elongated and acute in some; the antennæ are ordinarily longer than the head and thorax. The feet are not contractile. Their habits are unknown; many are, however, found upon plants in moist places. They may be united into a single genus,

CEBRIO, Oliv., Fabr.

In a first subsection, establishing a connexion between this and the preceding tribe, the species have the body of a consistence as solid as in the Sternoxi, and of an oblong-ovate form; the mandibles advanced beyond the labrum, narrow, very much bent; the antennæ flabellate or pectinated in the males of most of the species, or rather thickened at the tips. This subsection consists (with one exception) of species not inhabiting our country, and comprises several genera, including *Physodactylus* and *Cebrio*, in which the prosternum is produced into a point, and received into a notch of the mesosternum; and *Anelastes*, Kirby; *Callirhipis*, Latr.; *Sandalus*, Knoch.; *Rhipicera*, Latr., and *Ptilodactyla*, Illiger; most of which are formed of South American insects, the males of many of which are remarkably distinguished by their branched or pectinated antennæ. These also differ from the preceding in the prosternum not being remarkably prolonged into a point, and in the mesosternum wanting the frontal impression. In several of the last-named genera the joints of the tarsi are lobed beneath, and in the genus *Dascillus*, Latr.; *Atopa*, Fabr., which has the 11-jointed antennæ simple in both sexes, the three basal joints of the tarsi are without these membranous lobes, but the fourth joint is deeply bilobed, and the terminal joint without an appendage between the claws. Type, *Atopa cervina*, Fab. A common British insect.

In the second division of the Cebrionites the mandibles are small, but little or not at all extended beyond the labrum; the body generally soft, nearly hemispheric or ovoid, and the palpi pointed at the tip. The antennæ are simple, or but slightly toothed; in many the hind-feet are used for leaping. They frequent aquatic places. [These are minute insects.]

Elodes, Latr.; *Cyphon*, Fab., Dej., has the posterior thighs scarcely differing in size from the others. [Several minute British species.]

Scyrtes, Latr., has the hind thighs very large, and used for leaping. These two have the penultimate joint of the tarsi bilobed; in the two following it is entire.

Nycteus, Latr., has the third joint of the antennæ very minute, and the spurs of the hind tibiæ distinct.

Eubria, Zeigl., has the second joint of the antennæ minute, and the spurs of the hind tibiæ almost obsolete. *Cyphon palustris*, Germar. [A minute species, recently captured in Scotland.]

The second tribe of the Malacodermi, that of the *Lampyrides*, is distinguished from the preceding by the thickened tips of the palpi, or at least of the maxillary palpi; the body always soft, straight, depressed, or scarcely convex; and the thorax, either semicircular or nearly square, advanced over the head, which it wholly or partly covers. The mandibles are generally small, terminated in a slender curved point, entire at the tip; the penultimate joint of the tarsi is always bilobed, and the ungues of the tarsi are neither toothed nor furnished with any appendage. The females of some species are destitute of wings, or have only short elytra. When seized, these insects fold their antennæ and feet close to the body, without making any movement, as if dead; many also bend down the abdomen. They form the genus

LAMPYRIS, Linn.

A first division has the antennæ arising close together; the head either free and produced into a muzzle, or entirely concealed beneath the thorax, with the eyes of the males very large and globular, and the mouth small.

Lycus, Fab., having the muzzle very long;

Dictyoptera, Latr., with the muzzle very short; and

Omalisus, Geoffr., without any distinct muzzle; are distinguished for the want of the power of emitting light. [There is one British species, *L. minutus*, Fabr., belonging to the second of these groups; it is small, of a black colour, with red elytra.]

The other *Lampyrides* of this first division differ from the former, not only in not having a muzzle, and in having the head, which is occupied almost entirely by the eyes in the males, entirely or nearly hidden beneath the semicircular or square thorax; but also in a very remarkable property which they possess, either common to both sexes or peculiar to the females alone—that of being phosphorescent; whence these insects have obtained the names of Glow-worms and Fire-flies. The body of these insects is very soft, especially the abdomen: the luminous matter occupies the under-side of the two or three terminal segments of this part of the body, which are differently coloured, and generally yellow or white. The light they emit is more or less bright, and of a greenish-white, or white colour, like that of different kinds of phosphorus. It appears that these insects are able at will

to vary its action, which is especially the case when they are seized or held in the hand. They live for a very long time in a vacuum, or in different gases, except nitric, muriatic, and sulphuric acid gas, in which they die in a few moments. Their immersion in hydrogen gas renders them, at least sometimes, detonating. When deprived by mutilation of this luminous part of the body they survive, and this detached part preserves for some time its luminous powers, either when submitted to the action of different gases, in vacuo, or in the open air, its phosphorescence depending upon its moistness rather than on the life of the animal, as it is easily re-lighted on moistening the substance with water; it appears much more bright also when immersed in warm water, which is the only fluid capable of dissolving it.

These insects are nocturnal in their habits, the males being occasionally seen flying, like moths, round lights; whence we conclude that the luminous property of the females has for its object the attraction of individuals of the other sex; and if, as De Geer states, the larvæ and pupæ of the common Glow-worm are luminous, it is only to be attributed to the developement of this phosphoric substance from the earliest age. The males themselves also possess this power, but in a very slight degree. Nearly all the species of hot climates have both sexes winged, and as they occur in great quantities, they exhibit a brilliant spectacle to the inhabitants.

Amydetes, Hoffm., comprises some Brazilian species, having the antennæ composed of more than eleven joints, and strongly plumose.

Phengodes, Hoffm., also consists of other South American species, with only eleven joints in the antennæ, the third and following joints emitting two long ciliated and curled filaments.

The remaining species compose the restricted genus

Lampyris, divisible, from the form of the antennæ, the presence or want of elytra and wings, &c., into many minor groups. [See Laporte's revision of this genus in the *Annals of the French Ent. Soc.*]

L. noctiluca, Linn., the male of which is nearly half-an-inch long, and has simple antennæ; a semicircular thorax entirely covering the head, with two transparent spots; belly black; last segments of a pale yellow. The female is destitute of wings and elytra, and is of a blackish colour; the apex paler; the latter are more especially called Glow-worms. They are found in the country, at the side of roads, in hedges, amongst grass, &c., in the months of June, July, and August. They lay a great number of eggs, which are large, spherical, and of a citron colour. The larva nearly resembles the female, but is black, with a pale spot at the hinder angles of the segments; the antennæ and legs being much shorter, they crawl slowly, and are able to shorten and lengthen their bodies. They are probably carnivorous.

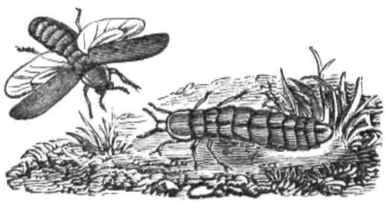

Fig. 59.—Male and female Glow-worm.

In our second division of the *Lampyrides* the antennæ are wide apart at the base; the head is not formed into a muzzle, and the eyes are of the usual size in both sexes.

Drilus, Oliv., has the antennæ pectinated in the males, and shorter and subserrated in the females; the maxillary palpi are thickened towards the end, which is pointed. The males are alone winged, the female of the typical species, *D. flavescens*, only recently discovered, being apterous, and nearly three times the size of the male. M. Mielzinsky has lately observed the transformations of this species, the larva of which feeds upon the common snail, *Helix nemoralis*, Linn., and resembles that of a Glow-worm; but the sides of the abdomen have a row of conical tubercles, and two series of pencils of hairs. Not having traced the transformations of the other sex, M. Mielzinsky regarded the female as forming a distinct genus, which he named *Cochleoctonus*.

All the other species belonging to this section or division of the *Lampyrides* are winged, and their maxillary palpi are not much longer than the labial.

Telephorus, Schæff.; *Cantharis*, Linn., has the palpi terminated by a hatchet-shaped joint, and the thorax has not lateral notches. The species are carnivorous, and crawl about on plants. *Cantharis fusca*, Linn., is one of the commonest species of this numerous group, [which are called Soldiers and Sailors by children]. Its larva is subcylindric, elongated, soft, and of a velvety black colour; the head is furnished with strong mandibles. Beneath the terminal segment of the body is a fleshy tubercle, used in walking. It lives in damp earth, and feeds upon prey. In certain years large spaces of ground in Sweden, covered with snow in the winter, have been observed covered with great numbers of these larvæ and other living insects, supposed to have been raised and transported thither by violent gales of wind, whence the origin of insect rain, "*pluie d'insectes.*"

Silis, Meg., has the thorax notched at the sides behind. *S. spinicollis*, Charp.

Malthinus, Latr., has the palpi terminated by an ovoid joint, and the elytra are shorter than the abdomen. The species are very small, and are found upon plants.

The third tribe of the *Malacodermi*, or the Melyrides, has the palpi generally filiform and short; the mandibles notched at the point; the body generally long and narrow; the head only covered at the base by a flat or slightly convex thorax, which is generally square or oblong; the joints of the tarsi are entire; the ungues unidentate, or furnished with a membranous appendage. The antennæ are mostly serrated or pectinated in some males. The majority are very agile, and are found upon leaves of flowers. This tribe, which is only a dismemberment of the genera *Cantharis* and *Dermestes*, Linn., composes that of *Melyris*, Fabr.

Malachius, Fabr., has beneath each of the anterior angles of the thorax and each side of the base of the abdomen a retractile vesicle capable of dilatation, and which the animal protrudes when it is alarmed, but of the use of which we are ignorant. The body is shorter than in the following genus, with the thorax broader than long. One of the sexes has in some species a hook at the tip of the elytra; the basal joint of the antennæ is often dilated and irregular-shaped in the males; their colours are agreeable. [These are active, pretty little insects, found in the spring and summer months, especially frequenting umbelliferous plants to prey upon the weaker insects which inhabit those flowers.] Types, *Cantharis ænea*, Linn., and *Cantharis bipustulata*, Linn. [two very common British species].

Dasytes, Fabr., has filiform palpi; the thorax is not furnished with vesicles; the antennæ at least as long as the head and thorax, and the body generally narrow, and sometimes linear. *D. cæruleus*, Fabr.

Zygia, Fabr., and *Melyris* proper are composed of exotic species, having the ungues unidentate; the antennæ shorter than the head and thorax, and the body shorter and of a more solid consistence.

Pelecophorus, Dejean, has the maxillary palpi terminated by a large hatchet-shaped joint. *Notoxus Illigeri*, Sch.

Diglobicerus, Latr., has the antennæ only distinctly 10-jointed, the last two joints being large and globular.

The fourth tribe of the Malacodermi, that of the *Clerii*, so named from the typical genus *Clerus*, is distinguished by the following characters:—Two of the palpi at least are advanced, and terminated in a mass; the mandibles are dentate; the penultimate joint of the tarsi bilobed, and the first very short, or indistinct in many species; the antennæ are either filiform or serrated, and sometimes clavate, or gradually thickened to the tips; the body is ordinarily almost cylindrical, with the head and thorax narrower than the abdomen, and the eyes notched. The majority are found upon flowers, and the others upon the trunks of old trees, or in dry wood. Such of the larvæ as have been observed are carnivorous. This tribe comprises the genus

CLERUS, Geoff.,—

Some of which have the tarsi, when seen either from above or below, distinctly 5-jointed; and the antennæ are always dentated like a saw.

Cylidrus, Fabr., having long entire mandibles (type, *Trichodes cyaneus*, Fabr., from the Isle of France); and

Tillus, Oliv., having the mandibles of moderate size, and notched at the tip (type, *Tillus elongatus*, Oliv., a rare British species), have the maxillary palpi filiform, or but slightly thickened at the tips; whilst

Priocera and *Axina*, Kirby, founded upon Brazilian insects, have all the palpi terminated by a mass, the last joint of the labial palpi being always hatchet-shaped.

Eurypus, Kirby, differs from the last two in having only the penultimate joint of the tarsi bilobed. This is also founded upon a Brazilian species.

In others the tarsi, when seen from above, only appear to be composed of four joints, the first of the five ordinary joints being very short, and concealed beneath the second.

Thanasimus, Latr., *Clerus*, Fabr., having the maxillary palpi filiform (type, *Attelabus formicarius*, Linn.); and

Opilo, Latr., *Notoxus*, Fabr., having all the four palpi terminated by a large hatchet-shaped joint (type, *Attelabus mollis*, Linn.), have the antennæ gradually thickened to the tip, but in the remaining groups the last three joints form a sudden mass.

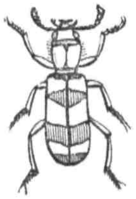

Fig. 60.—Clerus alvearius.

Clerus, Geoff. (*Trichodes*, Fabr.), has the maxillary palpi terminated by a reversed triangular compressed joint, whilst that of the labial is larger, and hatchet-shaped; the joints of the club of the antennæ are close together; the thorax is depressed in front. The perfect insects are found upon flowers, but the larvæ feed upon the grubs of some kinds of Bees.

Trichodes alvearius, Fabr.—Blue, with red elytra banded with blue; lives in the nest of Mason Bees (*G. osmia*, Reaum.), and feeds at the expense of their posterity. The larva of *Attelabus apiarius*, Linn., devours that of the Honey Bee, and often does much damage in hives.

Necrobia, Latr. (*Corynetes*, Fabr.), has the four palpi terminated by a joint of the same size, in the form of an elongated and compressed triangle; the joints of the club of the antennæ apart, and the thorax is not depressed in front. *Necrobia violacea*, Oliv.; *Dermestes violacea*, Linn. Very common in houses and upon carcases.

Enoplium, Latr., has the ninth and tenth joints of the antennæ produced on the inside into a long tooth. *Tillus serraticornis*, Oliv.

The fifth tribe of the Malacodermi, that of the *Ptinores*, has for its type the genus *Ptinus*, Linn., and some others which are derived from, or most nearly approach it. The body of these insects is of rather solid consistence, sometimes ovoid or oval, or sometimes cylindrical, but generally short, and rounded at each end; the head is almost orbicular, and received in the thorax, which is very much swollen, or hood-shaped; the antennæ of some are filiform, or become gradually slender to the tip, either simple or flabellate, pectinated or serrated, and those of others terminate in three joints abruptly thicker and longer than the preceding joints; the mandibles are short, thick, and toothed; the palpi are very short, and terminated by a larger joint, almost oval, or reverse triangle-shaped; the tibiæ are not toothed, and the spurs at their tips are very small; their colours are always obscure and but slightly

variegated. All these insects are of small size. When touched, they counterfeit death by lowering the head, inclosing their antennæ, and contracting their feet, remaining in this position for some time. Their movements are in general rather slow; the species which have wings seldom use them for escape. Their larvæ are very injurious, and bear a great resemblance to those of the Scarabæi; their body, which is generally curved, is soft and whitish, with the head and feet brown and scaly; their mandibles are strong; they construct, with the fragment of the materials they have gnawed, a cocoon, in which they change to pupæ. Other species take up their abode in old wood-stakes or under stones: in other respects their habits are similar. Such are the general characters of the genus

PTINUS, Linn.

Some have the front of the body narrower than the abdomen, and the antennæ simple or slightly serrated, and at least as long as the body.

Ptinus, Linn., has the antennæ inserted below the eyes, and the body is oblong. These insects frequent houses, and especially granaries, and the uninhabited portions of the former. Their larvæ devour dried plants, and the prepared dry skins of animals. The antennæ of the males are longer than those of the females, and in many species the latter are wingless. *Pt. fur*, Linn.

Gibbium, Scop., has the antennæ inserted in front of the eyes, and the body is short, nearly globular. *Pt. scotias*, *Pt. sulcatus*, Fabr. [This last is the type of Leach's genus *Gibbium*, having the thorax sulcated.]

The others have the body either oval or ovoid, or nearly cylindric; the thorax as broad as the abdomen; the antennæ either uniform and serrated, or pectinated, or terminated by three large joints; they are also shorter than the body.

Ptilinus, Geoff., has the male antennæ strongly pectinated, and the female serrated. *Pt. pectinicornis*, Fabr.

Xyletinus, Latr., and *Ochina*, Zeigl., have the antennæ simply serrated in both sexes.

Dorcatoma, Herbst., has the antennæ suddenly terminated by three large joints, and only 9-jointed. *D. dresdensis*, Herbst.

Anobium, Fabr., has the antennæ also terminated by three large joints, but they are 11-jointed. Many species of this genus inhabit the interior of our houses, where they do much injury, in the larva state, by gnawing furniture, books, &c., which they pierce with little round holes, like those made by a fine drill. Their excrement forms the fine white powder observed in the holes of worm-eaten wood. Other larvæ feed upon flowers, wafers, collections of birds, insects, &c. The two sexes, when calling each other during the period of their amours, beat with their jaws upon the wood-work on which they are stationed, for a succession of times, mutually replying to each other. This is the cause of the noise, similar to the quickened ticking of a watch, which is often heard [especially in old houses], and which has received from the superstitious the name of the Death-watch.

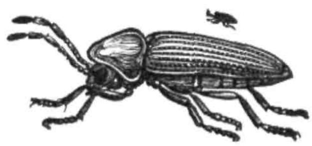

Fig. 61.—Anobium striatum, natural size and magnified.

Anobium striatum, Oliv. (*A. pertinax*, Fabr.), is of an uniform brownish-black colour, and is very common in houses. *A. pertinax*, Linn. [derives its specific name from the pertinacity with which it maintains its attempt at deception], preferring, according to De Geer, to suffer death under a slow fire, rather than give the least sign of life.

The third and last section of the Serricornes, forming also a last tribe—that of the *Xylotrogi*—is distinguished, as above stated, from the two preceding sections, by having the head entirely free, and is composed of the genus *Lymexylon*, Fabr., which we thus divide:—

Some have the maxillary palpi much longer; the labial pendent and brush-like in the males, terminated by a large ovoid joint in the females; the antennæ are short, and slightly thickened at the middle.

Atractocerus, Palis de Beauv., has the elytra very minute; the antennæ compressed, sub-fusiform; the thorax square, and the abdomen depressed. *A. necydaloides*, Pal. Guinea.

Hylecoetus, Latr., has the elytra nearly as long as the abdomen, the antennæ compressed, and the thorax nearly square. *H. dermestoides*, Linn. Inhabits Germany, England, and the north of Europe.

Lymexylon, Fabr., differs from the last in having the antennæ simple and sub-moniliform, and the thorax nearly cylindrical. *L. navale*, Fabr. This insect is very common in the oak forests of the north of Europe, but rare in the neighbourhood of Paris [and in England]. Its larva is very long, almost like a Filaria. Some time ago, it multiplied to such an extent in the dock-yards at Toulon that the injuries it committed in the wood-works were very great.

The others have the maxillary palpi very short, and alike in both sexes. The antennæ are always simple, and of equal thickness throughout.

Cupes, Fabr., has the antennæ composed of nearly cylindrical joints, and the penultimate joint of the tarsi is bilobed. *C. capitata*, Fabr. North America.

Rhysodes, Latr., has the antennæ moniliform, and all the joints of the tarsi are entire. *R. exaratus*, Dalm. Notwithstanding the number of joints in the tarsi, this genus approaches *Cucujus* and certain *Brenti* with a short rostrum in both sexes. Their habits are similar to those of the *Xylophagi*.

THE FOURTH FAMILY OF THE COLEOPTERA PENTAMERA,—

THE CLAVICORNES,—

Has, like the preceding family, four palpi; the elytra entirely cover the upper side of the abdomen, or its greater portion; the antennæ almost always thicker at the tips, and often terminated by a perfoliated or solid mass. They are larger than the maxillary palpi, with the base naked or but scarcely covered; the legs are not fitted for swimming, and the joints of the tarsi, or at least those of the posterior feet, are ordinarily entire. They feed for the most part in the larva state on animal matter.

We divide this family into two sections, the first of which has the following characters:—Antennæ always composed of eleven joints; longer than the head, but forming after the third joint a fusiform or cylindrical mass; the second joint not dilated into an ear-shaped appendage; terminal joint of the tarsi, as well as the ungues, small, or of moderate size.

These Clavicornes live out of water, whilst those of the second section are aquatic or subaquatic, and thus lead to the *Palpicornes*, which are for the most part aquatic, and of which the antennæ have not more than nine joints. The first section comprises several small tribes.

The first tribe, that of the *Palpatores*, appears to approach, in a natural series, the Pselaphi and Brachelytra, [in respect of their mouth-organs and habits]. Their antennæ (at least as long as the head and thorax) are slightly thickened to the tips, or are nearly filiform, with the two basal joints longer than the following; the head is separated from the thorax by a narrowed part; the maxillary palpi are long, advanced, and thickened at the tips; the abdomen is large, oval, or ovoid, and laterally embraced by the elytra; the legs are long, with the thighs clavate, and the tarsal joints entire. They are found on the ground under stones, &c. Some (*Scydmænus*) frequent damp places. We unite them into one genus,—

MASTIGUS, Hoff.

Mastigus, has the antennæ [elbowed], with the basal joint very long; the last two joints of the maxillary palpi form an oval mass; the thorax is ovoid. *M. palpalis*, Latr.

Scydmænus, Latr., has the antennæ scarcely elbowed, [the basal joint not being long]; the maxillary palpi are terminated by a minute pointed joint, and the thorax nearly globose. *S. Helwigii*, Latr. M. Duros discovered *S. clavatus*, Gyll., in an ant's-nest, which tends to confirm my views of the relation of this genus with the Pselaphi, at the end of the Brachelytra.

In all the Clavicornes following, the head is generally received into the thorax; and the maxillary palpi are never porrected and clavate at the same time. The whole of their appearance exhibits other distinguishing characters.

The genus *Hister* forms our second tribe, named *Histeroides*. The four hind legs are wider apart at their insertion than the two anterior, which character alone distinguishes this genus from all the others of this family; the feet are contractile, and the outer edge of the tibiæ is toothed or spinose; the antennæ are always elbowed, and terminated by a solid mass, composed of joints very close together; the body is of a very solid consistence, generally square, or parallelopiped, with the prosternum often dilated in front, and the elytra truncate; the mandibles are strong, advanced, and often of unequal size; the palpi are nearly filiform, or slightly thickened at the tips, and terminated by an oval or ovoid joint. In relation to their habits, the toothing of their tibiæ, &c., these insects approach the Coprophagous Lamellicornes; but in other respects, chiefly anatomical, they naturally approach the Silphæ.

These animals feed on cadaverous or stercorareous matters, rotten vegetable substances, such as manure, old fungi, &c. Others reside under the bark of trees. They creep slowly; they are of a very shining black or bronzed colour. Such of the larvæ as have been observed feed upon the same substances as the perfect insects. Their bodies are of a linear form, depressed, nearly smooth, soft, and of a yellowish white colour, with the exception of the feet and first segment of the body, of which the skin is scaly, and of a brown or reddish colour; it is furnished with six short feet, and terminated behind in two articulated appendages and an anal tubular elongation; the scaly plate of the first segment is longitudinally channelled.

This tribe exclusively comprises, as above said, the genus

HISTER, Linn.

Some of these have the tibiæ, at least those of the fore-legs, triangular, and toothed on the outer edge; the antennæ always exposed and free; the body generally square, and but little if at all thickened.

Hololepta, Payk., has the body very much flattened; the prosternum is not advanced over the mouth, and the four posterior tibiæ have only a single row of spines. These insects are found beneath the bark of trees. The larva figured by Paykull as that of one of these insects, belongs to the genus Syrphus or Musca.

Hister is composed of species having the prosternum advanced over the mouth, with the maxillæ terminated by a short lobe, and the palpi but little advanced; some of which have only a single row of spines on the four hind tibiæ. These also live under the bark of trees, and compose Leach's genera *Platysoma* and *Dendrophilus*; the first of which has the body flattened, *H. picipes*, Fabr. Those species which have two rows of spines on the four hind tibiæ compose Leach's restricted genus *Hister*. Ex., *H. unicolor*, Linn., one-third of an inch long; entirely black and shining, and extremely common. M. Paykull has employed the number of teeth in the tibiæ, and of the striæ and punctures of the thorax and elytra, as well as the form of the body, to distinguish the species.

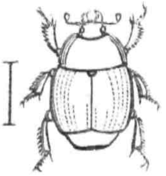
Fig. 62.—Hister unicolor.

A terminal division of this tribe comprises those Histeroides of very small size, having a nearly globose thick body, with the prosternum but slightly compressed at the sides; not advanced over the mouth, and straight in front.

Abræus, Leach, has the prosternum prolonged as far as the anterior angles of the thorax, entirely concealing the antennæ when retracted. *H. globosus*, Payk.

Onthophilus, Leach, has the prosternum narrowed, and the club of the antennæ lodged in an orbicular cavity situated beneath the anterior angles of the thorax. *H. sulcatus*, Pk.

Ceutocerus, Germar, appears to approach Hister in the form of the antennæ, feet, &c., but the elytra entirely cover the abdomen, and the jaws are not exserted.

[The monograph of the genus Hister, by Paykull, published at Upsal, 1811, and Sturm's *Deutschlands Fauna*, contains descriptions and figures of a great number of species; whilst Dr. Erichson has added considerably to the number of generic groups in the tribe, in an admirable memoir published in Dr. Klug's *Jahrbucher*.]

The other Clavicornes have the feet inserted at equal distances apart. Such of these insects as have these organs not contractile, or with the tarsi merely folded upon the tibiæ, the mandibles generally exposed and flattened, or but little thickened, and the prosternum dilated in front, compose five other tribes.

The third tribe, *Silphales*, possesses five very distinct joints in all the tarsi, and the mandibles are terminated in an entire point, without notch or slit. The antennæ are terminated generally in a perfoliated club of four or five joints. The maxillæ have generally a horny tooth on the inner edge; the anterior tarsi are often dilated, at least in the males; the elytra of the greater number have a depressed line along the outer edge, which is turned up. This tribe consists of the genus

SILPHA, Linn. (*Peltis*, Geoffr.).

Sphærites, Duftsch., *Sarapus*, Fisch., has the antennæ suddenly terminated in a short solid mass, formed of the last four joints; the second is larger than the following. The body nearly square; elytra truncate: tibiæ dentate. These insects so nearly resemble Hister, that Fabricius united them with that genus. Type, *Hister glabratus*, Fabr. [an insect of small size, lately detected in Scotland].

The rest have the antennæ terminated in a perfoliated mass.

Some of these have the body oblong, with the head narrowed into a neck behind the eyes; as broad, or scarcely narrower, than the front margin of the thorax; the elytra are oblong; truncate behind; the hind thighs, at least in the males, are generally thickened, and the anterior tarsi are dilated in the males.

Necrophorus, Fabr., has the antennæ terminated by a nearly globular 4-jointed mass; the body is parallelopiped, and the maxillæ want the horny tooth. The instinctive habits which these insects possess of burying small quadrupeds, has caused them to be named Sexton, or Burying Beetles. When a dead Mouse or Mole, &c. is observed, these insects creep beneath it, dig away the earth until the hole is sufficiently deep to receive the animal, which they pull in towards them, and in which they then deposit their eggs, the larvæ feeding upon the carcase. These larvæ are long, of a greyish white, with the upper side of the anterior segments armed with a scaly plate of a brown colour, and with small elevated points upon the posterior. They have six legs and strong mandibles. Previous to assuming the pupa state they bury themselves deeply into the earth, where they construct a cell, which they line with a glutinous secretion. These insects, like many others equally carnivorous, have a strong smell of musk. It appears that their powers of scent must be very great, as in a very little time after a Mole has been killed some of them are seen hovering over the body, although they had not been previously observed in the vicinity. The digestive canal of the Necrophori and Silphæ is at least three times as long as the body; the intestinal canal is very long.

Necrophorus vespillo, Linn., is from two-thirds to seven-eighths of an inch long; black, with the three terminal joints of the antennæ red, and two orange-coloured bands on the elytra; the coxæ of the hind-legs armed with a strong tooth. [There are several species closely allied to this insect, which is very common in England; and it is to be observed that they occasionally frequent rotten fungus and boleti, as well as animal matter in a decaying state.] Some of the species from North America surpass the rest in size.

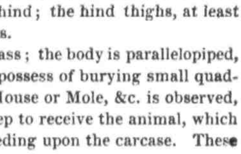
Fig. 63.—Necrophorus vespillo.

Necrodes, Wilkin; *Silpha*, Linn., has the antennæ evidently longer than the head, and terminated by an elongated 5-jointed mass; the body is oval oblong;

the thorax nearly orbicular, and the spurs of the tibiæ of ordinary size. The species are found in Europe, the equatorial parts of the New World, India, and Australia. [The type, *Silpha littoralis*, Fabr., is a very common English insect.]

Others of this subdivision have the body oval or ovoid, with the head not, or scarcely, narrowed behind, and narrower than the thorax, which is nearly semicircular; the elytra are rounded, or slightly emarginate at the tip; the legs scarcely differ in the sexes, and the maxillæ have an inner horny tooth.

Silpha, Linn., has the body nearly shield-shaped, depressed, with the thorax semicircular and the palpi filiform. The majority reside in [and feed upon] carcases, and thus diminish the quantity of obnoxious vapour which they emit. Some creep upon the stems of plants, especially of corn on which small Snails have crawled, in order to devour these animals; others mount high trees to feed on Caterpillars. Their larvæ are equally active, live in the same manner, and are often found collected in great numbers. They bear much resemblance to the perfect insect; the body is depressed, composed of twelve segments, with the posterior angles acute, the extremity of the body being narrowed, and terminated by two conical apppendages. In the majority of the species the two anterior tarsi of the males are alone more dilated than the rest. The species with the extremity of the antennæ distinctly perfoliated or with transverse joints, forming a sudden club, with the elytra notched at the tips, forms Leach's genus *Thanatophilus* (*S. sinuata*, Fab., &c.), whilst those with similar antennæ, but with the elytra entire, form his genus *Oiceoptoma* (type *S. thoracica*, Linn., of a black colour, with the thorax red, silky, and with three elevated lines; is chiefly found in woods.) Those species which have the antennæ perfoliated, but with the club gradually formed, are retained under the generic name of *Silpha* by Leach. They are generally found in fields, on the borders of paths, &c.: example, *Silpha lævigata*, Fab.; shining black, with the thorax much narrowed in front, and the elytra without elevated lines: *S. obscura*, Linn., *S. reticulata*, Linn., &c. In some the terminal joints of the antennæ are globular and not perfoliated; these form the genus *Phosphuga* of Leach: ex. *S. atrata*, Fab., &c.

A German species (*S. subterranea*, Illig.), having the four anterior tarsi alike dilated at the base in the males, and the five terminal joints of the antennæ forming a perfoliated club, may be formed into another subgenus, *Necrophilus*, Latr.

Agyrtes, Froehl., has the body thick, convex above, not shield-like, thorax nearly square, and the edge of the elytra not margined. *A. castaneus*, Gyll.

Those *Clavicornes* which appear to us to approach Agyrtes, both in respect to their characters and habits, but which have the mandibles notched or bidentate at the tip, form the fourth tribe, *Scaphidites*. Their tarsi have five distinct and entire joints, the body is oval, narrowed at both ends, convex above, thickened in the middle, with the head low, and received posteriorly in a trapezoidal thorax. The antennæ are generally as long as the head and thorax, and terminated by an elongated 5-jointed mass; the legs are long and slender. Except in the Cholevæ, the tarsi are identical in the sexes. This tribe consists of the genus

SCAPHIDIUM, Oliv.

Scaphidium proper, has the five terminal joints of the antennæ nearly globular, and forming the club. The maxillary palpi are but little porrected, and terminate gradually in a point; the body is navicular, and the elytra truncate. They reside in boleti. Few species are known, one inhabiting Cayenne, the others the north of Europe. [*S. quadrimaculatum*, a very pretty and rare British species; black shiny, with four red spots on the elytra.]

Choleva, Latr., has the club of the antennæ composed of more or less perfoliated joints; the maxillary palpi are much exposed, and suddenly terminated like an awl; body ovoid, thorax flat; the four basal joints of the anterior and the basal joint of the intermediate tarsi are dilated as in the males of some species. (*Catops blapoides*, Germ.) In Choleva proper, the antennæ are about as long as the head and thorax, the eighth joint is evidently shorter than the preceding and following, and sometimes scarcely distinct, and the last is pointed. In *Mylæchus*, Latr., *Catops*, Payk., Gyll., the antennæ are shorter, the eighth joint being longer than the preceding, and the last rounded at the tip. (See the monograph on Choleva, by W. Spence, published in the *Transactions of the Linnæan Society* of London.)

The fifth tribe, *Nitidulariæ*, approaches the Silphales in the shield-shaped, margined body, but the mandibles are bifid at the tips, the tarsi appear only 4-jointed, the basal and following joint in some being only visible on the under-side; the penultimate joint in others is very small, nodose, and hidden between the lobes of the preceding; the club of the antennæ is always perfoliated, and composed of three or two joints, and generally short, or but little elongated. The palpi are short and filiform, the elytra short and truncated in some species. The habitation of these insects varies according to the species, being found in flowers, boleti, fungi, waste victuals, and under the bark of trees. They form the genus

NITIDULA.

Colobicus, Latr., has the club of the antennæ only 2-jointed; the front of the head is produced like a semicircular clypeus, covering the mandibles and other parts of the mouth; the tarsi appear only 4-jointed, the real basal joint being only visible on the under-side.

All the other *Nitidulaires* have the antennæ terminated by a 3-jointed club, and the front of the head is not produced over the mouth.

Thymalus, Latr., agrees with Colobicus in having the basal joint of the tarsi very short, and the three following long and entire In the nearly hemispherical species (*T. limbatus*), the club of the antennæ is shorter.

The following have the three basal joints of the tarsi, at least in the males, short, broad, and bilobed, the fourth being very small and scarcely apparent, with the maxillary palpi filiform.

Ips, Fab., having the body oval-oblong, depressed, with the posterior extremity of the body exposed, and with one of the mandibles (the left) truncated and tridentate at the tip, and the other broadly notched. [The species are mostly small, of a black colour, with red spots on the elytra.]

Nitidula, Fab. (*Strongylus*, Herbst.), have both the mandibles narrowed at the tip and terminated in a bifid point. Some are flattened, oblong, or ovoid, others orbicular and gibbose, or proportionately more convex than the preceding. *N. ænea*, Fabr., is found very abundantly in flowers: it is very small, of a shining bronzed green colour, with the antennæ black, and the feet brownish black or fulvous. [*N. grisea* is one of the commonest British species, larger than the preceding, and generally found under the bark of willow-trees, where its larva also resides.]

Fig. 64.—Nit. grisea.

Cercus, Latr. (*Catheretes*, Herbst.), differs from the two preceding in having the second and third joints of the antennæ nearly of equal size, the club elongated and pear-shaped, (and not suddenly formed and orbicular or oval); the body is depressed, and the elytra are truncate. [Very small species, found in flowers.]

Byturus, Latr., differs from all the preceding by having the tibiæ long, narrow, and nearly linear, the elytra covering the body, and not truncated at the tip, the body oval, and the club of the antennæ oblong. [*B. tomentosus*, a small species of very common occurrence, the larva of which feeds in the interior of ripe raspberries.]

The sixth tribe, *Engidites*, agrees with the last in having the mandibles notched at the tip, but differs in these organs scarcely extending beyond the sides of the labrum; the body is oval or elliptic, with the anterior extremity of the head slightly advanced into an obtuse point. The tarsi have five distinct joints (some male Cryptophagi excepted, which are heteromerous), entire, and merely slightly villose beneath; the penultimate joint is but a little shorter than the preceding, the antennæ terminate in a perfoliated mass of 3 joints, the elytra entirely cover the abdomen, the palpi are slightly thickened at the tips. Some of the species, of very small size, live in the interior of houses. These Clavicornes may be united into a single genus,

DACNE.

Dacne, Latr. (*Engis*, Fabr.), has the antennæ terminated suddenly in a large orbicular, or ovoid, and compressed close mass.

Cryptophagus, Herbst., has the antennæ moniliform, with the second joint as large or larger than the preceding, and terminated less suddenly by a narrower club with more distinct joints. [Minute domestic insects.]

Antherophagus, Knoch, has the antennæ proportionably thicker, composed of transverse joints, and terminated gradually by a club, the second and the eighth joints being nearly equal-sized.

Triphyllus, Meg., Dej., differs only from Cryptophagus in the number of the joints of the tarsi.

We now pass to some tribes having the prosternum often dilated in front like a cravat, and which differ from the preceding in having the feet more or less contractile, the tibiæ being folded against the thighs, even though the tarsi may be free. The mandibles are short, thick, and toothed, the body is ovoid, thick, and clothed with scales, or hairs, easily abraded, which give it a diversified colour. The larvæ are hairy, and feed for the most part on the skins or carcases of animals, many of them being very injurious in collections of insects. Such of them as have not the feet perfectly contractile, the tarsi remaining free, with the tibiæ long and narrow, form our seventh tribe, *Dermestini*, and the genus

DERMESTES, Linn.

Aspidiphorus, Zeigl., has only ten distinct joints in the antennæ, the palpi very short, and the body orbicular. *Nitidula orbiculata*, Gyll., [a minute British species].

The following have eleven distinct joints in the antennæ, and the palpi are filiform, or thickened at the tips. Some of these have the antennæ not received in particular cavities on the under-side of the thorax.

Dermestes proper, has the antennæ smaller in both sexes; the length of the terminal joint scarcely exceeding that of the preceding. Some of these insects commit great ravages in fur-warehouses, cabinets of natural history, &c., *D. lardarius* gnawing to pieces the insects in collections into which it may happen to make its way; others feed upon carcases.

Dermestes lardarius, Linn., is black, with the base of the elytra gray spotted with black; its larva is long, gradually narrowed from the front to the extremity of the body; dark brown above, white beneath, with long hairs, and two horny hooks on the last segment of the body.

Megatoma, Herbst., has the club of the antennæ greatly elongated in the males, the last joint of a lanceolate form. *D. pellio*, Linn., is $2\frac{1}{2}$ lines long, black, with three white spots on the thorax, and one on each elytra. Its larva is very long, red brown, shining, with red hairs, those of the extremity of the body forming a tail.

Limnichus, Zeigl., differs from the last two subgenera in having the antennæ gradually clubbed; they are granular, and are lodged under the anterior angles of the thorax; the labial palpi are very small. *Byrrhus sericeus*, Dufts.

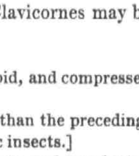

Fig. 65.—Dermestes lardarius

In all the following subgenera, the antennæ or their clubs are lodged in lateral cavities on the under-side of the thorax. The prosternum is always dilated like a cravat.

Attagenus, Latr., has the club of the antennæ very large, lax, and three-jointed, and the body short and slightly convex. *Dermestes Serra*, Fab.

Trogoderma, Latr., has the club of the antennæ lax, 4-jointed, and the body oblong. *Anthrenus elongatus*, Fab.

Anthrenus, Geoff., has the antennæ terminated in a solid obconical mass, lodged in short cavities beneath the fore angles of the thorax. The species of this genus are very small, living upon flowers in the perfect state, but feeding in the larva state on dried animal matters, especially preserved collections of insects. These larvæ are oval, clothed with hairs, which are sometimes denticulated, forming brushes, the posterior ones being elongated behind like a tail. The last skin of the larvæ serves as a cocoon for the pupa. *Byrrhus verbasci*, Linn.

Globicornis, Latr., has the antennæ terminated by a solid globular mass. *Megatoma rufitarsis*, Latr.

The eighth tribe, *Birrhii*, differs from the preceding in having the feet entirely contractile, the tibiæ folding upon the femora, and the tarsi upon the tibiæ, so that when these limbs are thus contracted and closely applied to the body, the animal seems absolutely destitute of feet and lifeless; the tibiæ are ordinarily broad and compressed, the body is short and convex. This tribe is composed of the genus

BYRRHUS, Linn.

Nosodendron, Latr., differs from the rest in having the mentum entirely exposed, wide, large, and shield-like, the antennæ suddenly terminated in a short 3-jointed mass. The species are found under the bark of trees.

Byrrhus proper, differs in having the mentum of the ordinary size. In some the antennæ increase gradually, or terminate in an elongated 5 or 6-jointed mass. *B. pilula*, Linn., three or four lines long, black beneath, bronzy black and silky above, with small black spots separated by paler coloured lines; [a very common species, found in the earth, and in sand-pits, &c.]

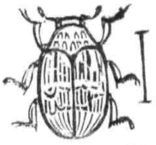

Fig. 66.—Byrrhus pilula.

A species with similar antennæ differs in having the fourth joint of the tarsus minute, and hidden between the lobes of the third. *B. striato-punctatus*, Dej. [This is the genus *O. omorphus*, Curtis.]

Another small and very hairy species has the club of the antennæ 3-jointed, (*Trinodes hirtus*, Cuv.)

Others have the club of the antennæ only 2-jointed, the last large and nearly globular. (*B. erinaceus*, Zeigl., *B. setiger*, Illig.) [These form the genus *Syncalypta*, Dillw.] All the Byrrhii are generally found in the ground and in sandy places. *Murmidius* belongs, according to Dr. Leach, to this family, but the antennæ are only 10-jointed, the last forming a club.

Our second section of the Clavicornes, although very natural, is only to be distinguished by a reunion of several characters. Some differ from the other Clavicornes in having only nine or six joints in the antennæ, in this respect approaching the next family. The antennæ of others are 11- or 10-jointed, but sometimes they are not longer than the head, forming after the third joint a sub-cylindrical, serrated mass: sometimes they are filiform, and as long as the head and thorax, but here the tarsi are terminated by a large joint with two strong hooks. Those of Heterocerus and Georyssus are only 4-jointed.

The body is generally ovoid, with the head immersed up to the eyes in a trapezoidal corselet, with the sides elevated, and terminated behind in acute angles; the prosternum dilated in front and the feet imperfectly contractile. They are found in water or under stones at its edge, often buried in the earth: some in the form of the antennæ approach the *Gyrini.*

I divide this section into two tribes.

The first tribe, *Acanthopoda*, is distinguished by its flattened feet, which are broad, and armed on the outside with spines, the tarsi short and 4-jointed, with ordinary sized claws, and the body depressed; the prosternum is dilated; the antennæ are rather longer than the head, curved, 11-jointed, the last six forming a nearly cylindrical serrated mass. This tribe is composed of a single genus,

HETEROCERUS, Bosc.

These insects are found in the ground at the edge of water, rushing from their retreats when the earth is shaken by the feet; the form of their feet allows them to dig in the ground, where they conceal themselves, the tarsi folding back. It is here where the larvæ also reside, as first observed by M. Miger.

H. emarginatus, Fab., is a small (common) insect, of a silky black colour, with paler buff variable markings; Gyllenhall has observed that the tarsi are in reality 5-jointed, the basal joint being minute.

The second tribe, *Macrodactyla*, comprises such Clavicornes as have the tibiæ simple, narrowed, with long tarsi composed of five joints (except in Georyssus), the last joint being large, with two strong ungues at the tip; the body is thick and convex; the thorax less rounded, and often with acute posterior angles. The chief type of this tribe is the genus

DRYOPS, Oliv. (*Parnus*, Fabr.),

Which is divisible as follows:—

First,—Those with very short 10 or 11-jointed antennæ, the third and following joints forming a subcylindrical, serrated mass.

Potamophilus, Germ. (*Hydera*, Latr.), have the antennæ not lodged in cavities, and rather longer than the head, with the first joint nearly as long as all the rest, and the second short and globular; the palpi are exserted and the mouth is naked. *Parnus acuminatus*, Fabr.

Dryops, Oliv., has the antennæ shorter than the head, and received in a cavity beneath the eyes, nearly covered by the second joint, which is large, dilated, and ear-like; the palpi are not exserted. Leach applies this generic name to *Dryops Dumerilii*, which differs from the others (which he names *Parnus*) in the length of the feet and form of the thorax, &c.

Second,—Those with filiform 11-jointed antennæ, at least as long as the head and thorax.

Elmis, Lat. (*Limnius*, Ill.), [insects of very small size], found in water, under stones, or the leaves of the water-lily

Third,—Those with very short 9 or 6-jointed antennæ, terminated in a nearly solid, oval, or globular mass.

Macronychus, Mull., has five distinct joints in the tarsi, the body oblong and antennæ 6-jointed. *M. 4-tuberculatus*, Mull.

Georissus, Latr., has only four distinct joints in the tarsi, the body short and nearly globular, and the antennæ 9-jointed. *Pimelia pygmæa*, Fab., [a very minute shining black insect, with deep rows of dots on the elytra; rather rare].

THE FIFTH FAMILY OF THE COLEOPTERA PENTAMERA,—

THE PALPICORNES,—

Possesses, like the last, antennæ terminated in a club, which is ordinarily perfoliated, but of not more than nine joints in any species, inserted beneath the lateral and advanced margins of the head; never longer than it and the maxillary palpi, and often shorter than the last-named organs; the mentum is large and shield-shaped. The body is generally ovoid, or hemispherical and convex. The feet are in the majority proper for swimming, and have only four or five distinct joints, the basal joint being much shorter than the following; all the joints are entire.

Those species which have the feet fitted for swimming, with the basal joint of the tarsi much shorter than the following, and the maxillæ entirely corneous, compose a first tribe, *Hydrophili*, which embraces the genus

HYDROPHILUS, Geoffroy,—

Which Linnæus regarded only as a first division of his genus Dytiscus, but the anatomy of the two groups differs materially: the digestive canal of the Hydrophili, in its great length and texture, having much analogy with that of the Lamellicornes, approaching the carnivorous tribes only in its biliary vessels.

Some of these have the body either oval, oblong, and depressed, or long and narrow, with the thorax rough and narrowed behind; the legs slender; the tarsi filiform, but slightly ciliated; the antennæ (always 9-jointed) terminating in an obconical and nearly solid club. These Palpicornes are all very small; they swim but little and badly, inhabiting stagnant water, which they occasionally quit in order to hide themselves in the earth or under stones. They compose the family *Helophoridea* of Leach, corresponding with the Fabrician genus *Elophorus*.

Elophorus, Fab., having the body oval, thorax transverse, and eyes slightly elevated; and

Hydrochus, Germ., having the body long and narrow, the thorax oblong, and the eyes prominent (*H. elongatus*, Fabr.), have the maxillary palpi terminated by an oval joint; whilst in

Ochthebius, Leach, the maxillary palpi are terminated by a more slender, short, and conical joint, and the thorax is nearly semiorbicular. *E. pygmæus*, Fabr.; *Hydræna riparia*, Latr.

Hydræna, Kug., has the maxillary palpi much longer than the head and antennæ, with the terminal joint larger than the preceding, fusiform, and pointed at the tip. They have the aspect of Ochthebius. *E. minimus*, Fab.; *Hydræna riparia*, Kugel.

The other Hydrophiliens have the body ovoid or subhemispherical, and generally convex, with the thorax much broader than long, the tibiæ and tarsi generally with long hairs. They compose the family *Hydrophilidea* of Leach, or the genus *Hydrophilus*, Fabr.

Spercheus, Fabr., has only six joints in the antennæ, and the clypeus is notched. *S. emarginatus*, Fabr. [a very rare British species].

Globaria, Latr., has the body nearly spherical, laterally compressed, and capable of being rolled into a ball like Agathidium. Its antennæ appear to be only 8-jointed, the fifth being dilated internally into a spine, the terminal joints forming a very elongated, nearly cylindrical club, pointed at the tip; the elytra entirely embrace the abdomen, the four posterior tibiæ having a brush of long hairs at the tip. The only species, *G. Leachii*, is small and exotic: I believe it to be from South America.

All the remaining Hydrophiliens have nine joints in the antennæ, with the club oval or ovoid, and the body not contractile into a ball.

Hydrophilus, Geoff., comprises the largest species in the tribe, with the two intermediate joints of the club of the antennæ obtuse at one end, and elongated, arched, and pointed at the other; the first joint of the club is

saucer-shaped, more elongated on the front side; the sternum is elevated in the middle into a keel, which is produced behind into a longer or shorter acute spine; the maxillary palpi are longer than the antennæ; the tarsi, especially of the hind legs, have a long row of fringes, and are terminated by small ungues of unequal size. In some the sternal spine is very much elongated behind, and the last joint of the anterior male tarsi is triangularly dilated. These are the *Hydrous* of Leach; one of which, *H. piceus*, Fab., is an inch and a half long, oval, and of a black brown colour and highly polished. [It is a common British species, frequenting ponds and ditches]; it swims and flies well, but walks badly; its sternal point is capable of inflicting a severe wound. The anus of the female is furnished with two spinnerets, with which it constructs an ovoid cocoon of silk, surmounted by a point like a curved horn; its outer surface is coated with gum, which renders it impervious to the water; and in its interior the eggs are symmetrically arranged. These cocoons float on the surface of the water.

The larvæ resemble worms, being soft and of an elongated conical form, with six feet; the head large and scaly, more convex below than above, and armed with strong mandibles; they respire by the extremity of the body, are very voracious, and feed on the young fry in fish-ponds. That of *H. piceus* is depressed, blackish, wrinkled, with the head reddish brown, round, and capable of being thrown back upon the back; by which means it is able to seize small shells floating on the surface of the water, its back serving it as a point d'appui for breaking the snail shell. They swim well, and have two fleshy appendages at the extremity of the body, used in enabling the insects to suspend themselves at the surface while in the act of respiration. Other larvæ of Hydrophili are destitute of these appendages, and are not able to swim, and do not suspend themselves in the same manner as the preceding. The females of these species swim with difficulty, and carry their eggs beneath the abdomen in a silken tissue; but these species belong to the extreme genera.

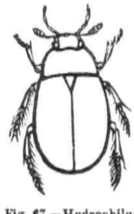
Fig. 67.—Hydrophilus caraboides.

Hydrophilus proper, of Leach, consists of species having the tarsi alike in both sexes and not dilated, with the sternal spine not extending beyond the metasternum. [*Hydrophilus caraboides*, a most abundant British species, of an olive-black colour.]

In the three following subgenera the middle joints of the club of the antennæ are not dilated and prolonged in front into a spine.

Limnebius, Leach, has the maxillary palpi much longer than the antennæ; the last joint shorter than the preceding, and cylindrical, and the tip of the elytra truncate. *H. griseus*, *truncatellus*, &c.

Hydrobius, Leach, has the maxillary palpi scarcely longer than the antennæ; the body convex; the eyes depressed, and the front of the head not suddenly narrowed. *H. scarabæoides*, *melanocephalus*, &c.

Berosus, Leach, differs from the last in having the eyes very prominent; the front of the head suddenly narrowed, and the thorax narrower at the base than the elytra; the body is very gibbose. *Hydr. luridus*, Fab.

The second tribe, *Sphæridiota*, is formed of terrestrial Palpicornes, with the tarsi composed of five distinct joints, the basal joint being at least as long as the second. The maxillary palpi are rather shorter than the antennæ. The body is nearly hemispherical, with the prosternum prolonged into a point at its posterior extremity, and the tibiæ spinose, the anterior being palmated or digitated in the larger species. The antennæ have always nine joints, or simply eight, if the last is considered as an appendage of the preceding. (See the Elaterides, and some other genera of Coleoptera.) These insects are small, and inhabit cow-dung and other excrementitial matter, and some species are found near the margins of water. They compose the genus

SPHÆRIDIUM, Fabr.

Sphæridium proper, of Leach, comprises only those species which have the anterior tarsi of the males dilated. *Dermestes scarabæoides*, Linn., is shining black, smooth, with very spiny feet, a spot of blood-red at the base of each elytron, and the tip reddish. These spots vary, and even disappear in some specimens [of this very common British insect].

The species which have the tarsi alike in the two sexes, with the mass of the antennæ loosely imbricated, form the genus [*Cercyon*, not] *Cercydion* of Leach; *Sph. unipunctatum*, Linn. The form of the tibiæ and the arrangement of the spines or teeth would enable us to divide Sphæridium into several other groups, which would facilitate the study of the species, which have probably been too much multiplied.

THE SIXTH FAMILY OF THE COLEOPTERA PENTAMERA,—

THE LAMELLICORNES,—

Has the antennæ inserted in a deep impression beneath the lateral margins of the head, always short, mostly composed of nine or ten joints, and terminated in all by a mass generally formed of the last three joints, which are lamellar; sometimes arranged like a fan, or the leaves of a book, opening and

shutting in the same manner; sometimes forming a concentric, contorted club, the first or the basal joint of the mass being in such case semi-infundibuliform, and receiving the others; sometimes arranged perpendicularly to the axis, and forming a kind of comb. The body is generally ovoid or oval, and thick, the outer edge of the anterior tibiæ is toothed, and the joints of the tarsi, except in some males, are entire, and without any brush or cushion beneath; the anterior extremity of the head is advanced and dilated, generally in the form of a shield; the mentum is generally large, and covers the tonguelet, or is incorporated with it, and bears the palpi; the mandibles of many are membranous, a peculiarity not found in any other coleopterous insect. The males often differ from the females either in the horns or tubercular elevations of the thorax or head, or in the size of their mandibles.

This family is of very great extent, and one of the most beautiful of the order, in respect to the size of the body, the variety in the form of the head and thorax in the different sexes, and often also in those species which in the perfect state live upon vegetable substances, in respect to the brilliancy of the metallic colours with which they are ornamented. But the majority of the other species, which subsist on decomposing vegetable matter, as manure, tan, or excrementitious matter, are generally of an uniform brown or black colour; some of the coprophagous species, nevertheless, are not inferior in this respect to the preceding. All have wings, and they crawl but slowly. The larvæ have the body long, nearly semicylindrical, soft, often transversely wrinkled, whitish-coloured, 12-jointed, with the head scaly, armed with strong jaws and six scaly feet. Each side of the body has nine spiracles; the posterior extremity is thickened, rounded, and generally curved beneath, so that these larvæ having the back convex or arched, are not able to extend themselves in a straight line, and crawl but badly on a smooth surface, and tumble sideways or back downwards at every step. A general idea of their form may be obtained from that of the grub so common in gardens and pastures, which produces the common Cockchaffer. Some species do not change to pupæ until they have passed three or four years as larvæ; they form for themselves in their retreats, with the earth or the debris of the materials they have gnawed, a cocoon of an ovoid form, or in the shape of an elongated ball, of which the particles are fastened together with a glutinous secretion. Their food consists of dung, manure, tan, the roots of vegetables, including some which are useful to Man, whence these insects occasionally cause much loss to the cultivator. The nervous system, considered in the larva and imago states, exhibits remarkable differences.

We divide this family into two tribes, the anatomy of which, according to Dufour, is so different as to raise them to the rank of two distinct families,—[*Scarabæides* and *Lucanides*].

The first, that of the

SCARABÆIDES,—

Possesses antennæ terminated in the majority by a club composed of leaflets capable of being shut up, and in the others consisting of box-like joints, either in the form of a cone reversed, or nearly globular; the mandibles are alike, or nearly alike, in the sexes, but the head and thorax of the males often exhibit prominences of peculiar form; sometimes also their antennæ are more developed. This tribe corresponds with the genus

SCARABÆUS, Linnæus.

We divide this genus into numerous small sections, founded upon the consideration of the masticatory organs, antennæ, and habits, the distinction of which sections has been confirmed by the anatomical researches of M. Dufour.

1. The *Coprophagi*, or the Scarabæides of our first section, have the antennæ generally composed of eight or nine joints, the last three of which form the knob; the labrum and mandibles are membranous and hidden. The terminal lobe of the maxillæ is also of this consistence, broad, and curved on the upper edge; the last joint of the maxillary palpi is always largest, and the last joint of the labial is slenderer than the preceding, or very small, behind each of which last palpi is a membranous production, or tonguelet. The sternum offers no particular prominence, and the claws of the tarsi are simple; the fore tarsi are often wanting, either naturally or from being worn away.

Some of the Coprophagi have the two middle legs much wider apart at the base than the others the labial palpi very hairy, with the last joint minute; the scutellum wanting, or very small.

Ateuchus, Weber (*Scarabæus* of the Latins and Mac Leay, *Heliocantharus* of the Greeks), consists of species peculiar to the old world, with the body rounded, generally depressed above, alike in both sexes; antennæ 9-jointed,

with a leaf-like club; four posterior tibiæ, slender, elongate, not thickened at the tip, truncated obliquely and terminated by a single spur, and with the outer margin of the elytra not sinuated near the base; the clypeus is generally divided into three lobes, its edge presenting six teeth.

These insects (which Mr. Mac Leay has described in his excellent *Horæ Entomologicæ*) inclose their eggs in balls of dung, or even of human excrement, like large pills, (whence they have been called *Pilularii*,) which they roll along with their hind feet (often in company), until they reach the hole in which they are to be deposited. Two of the species were worshipped by the ancient Egyptians, and introduced into their hieroglyphical writings. Their effigy is represented on all their monuments, models of them were made of the most precious materials, and formed into amulets, &c., suspended round the neck, and which were buried with the mummies. The insect itself has been found in some of their coffins.

Scarabæus sacer, Linn., found not only in the whole of Egypt, but in the south of France, Spain, and other southern parts of Europe, has until lately been regarded as the object of this superstition; but another species, discovered in Sennari by M. Caillaud, appears, from its more brilliant colours, and the country where it is found, and which was the first residence of the Egyptians, to have attracted their earliest attention. I have named it *Ateuchus Ægyptiorum*. (See my Memoir on the Insects painted and sculptured by the Egyptians, and the Works of Champollion.)—Some Ateuchi, having the thorax and abdomen shorter, more rounded, and more convex, form the genus *Pachysoma*, Kirby, (*S. Æsculapius*, Oliv. and *Hippocrates*). [*Mnematium*, Mac Leay, is closely allied to these. *M. Ritchii*, from the interior of Africa.]

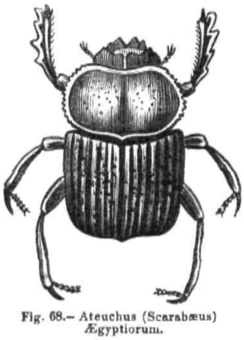

Fig. 68.—Ateuchus (Scarabæus) Ægyptiorum.

Gymnopleurus, Illig., differs in having the outer edge of the elytra strongly notched near the base. The four posterior tibiæ are very slightly spined. *Ateuchus sinuatus*, *pilularius*, &c.

Other Coprophagi, closely allied to the preceding, have the middle tibiæ (which as well as the posterior are often thickened at the tips) furnished with two spurs. The clypeus has in many species only four or two spines.

Sisyphus, Latr., has only 8-jointed antennæ, and the abdomen triangular, with very long hind legs. *At. Schæfferi*, Fab., and others [described by M. Gory in his Monograph on this genus].

Circellium, Latr., has the body hemispherical, the abdomen semicircular, scutellum wanting, and clypeus 6 or 4-toothed. *At. Bacchus* [Cape of Good Hope].

Coprobius, Latr., is composed of New World species, without a scutellum; body ovoid, not convex, and the sides of the thorax angular.

Chæridium, Serville and St. Fargeau, has shorter legs. We also unite their *Hyboma* with Coprobius.

Eurysternus, Dalm. (*Æschrotes*, Serv.), possesses a scutellum, with the body oval-oblong.

Oniticellus, Zeigl. (with the body oblong and scutellum distinct), and *Onthophagus* (without a scutellum, and the body short and broad), are exclusively distinguished by having the third joint of the labial palpi scarcely distinct, and the preceding larger than the first. The last-named group is further distinguished by the males having the head and thorax often cornuted. *S. taurus*, Linn. [a very rare British species], the male of which has two long curved horns on the head. [There are several other British species.] All the species are of small size.

Onitis, Fab. (having the second joint of the labial palpi largest, the scutellum distinct, and the fore tibiæ of the males long and curved), and *Phanæus*, Mac Leay, (having the first joint of the labial palpi largest, the scutellum replaced by a sutural space, the males cornuted, and the legs of equal size in both sexes, and composed of many fine and large exotic species,) differ from the rest in having the second joint of the club of the antennæ encased between the two outer joints, and the thorax large. (See the Monograph of this genus by Mac Leay, in the *Horæ Entomologicæ*.)

Copris, Geoffr., as now restricted, comprises only such as have the club of the antennæ formed of three plates; the four hind tibiæ greatly dilated and truncate at the tip; the scutellum wanting; the body thick and differing in the sexes. The largest species inhabit the tropical parts of Africa and the East Indies. *Scarabæus lunaris*, Linn. [is a local British species]. Eight lines long; black and shiny, with an erect horn on the head of the males. [It is found under dung in sandy places near London.]

The terminal Coprophagi have the legs inserted at equal distances apart, the scutellum very distinct, and the elytra covering the abdomen. In other respects they nearly approach the preceding subgenus, but the sexual differences are less strongly marked, consisting only in slight tubercles. They appear at the commencement of spring, [hovering over every fresh deposit of animal excrement. This is the family of *Aphodiidæ*, Macl.]

Aphodius, Illig., has the inner lobe of the maxillæ not corneous nor dentate, the body is rarely short, and the thorax not transversely strigose. *Scar. fimetarius*, Linn. [a very common British insect, and many other species].

Psammodius, Gyll., has the inner lobe of the maxillæ corneous and with two teeth, the body short, and the thorax transversely rugose.

Euparia, St. Farg. and Serv., also belongs to this section, apparently allied to Eurysternus.

Psammodius naturally conducts us to the following section, *Arenicoli*, which, with Aphodius and Psammodius, are the only species in which the elytra entirely cover the abdomen: the mandibles are horny, exposed, and curved; the terminal lobe of the maxillæ is straight, with few exceptions; the antennæ are 10 or 11-jointed. These Beetles also live in dung, and form deep burrows in the earth; they fly about in the twilight after sunset, and counterfeit death when alarmed. [The Arenicoli form two sections, corresponding to the families *Geotrupidæ* and *Trogidæ*, Mac Leay.]

In the *Geotrupides* the antennæ are generally **11**-jointed, the mandibles are generally exposed and curved, and the upper lip more or less exposed; the species are generally of black or red colours, with the elytra smooth or simply striated; the males are often cornuted. They chiefly feed upon excrementitious matter.

Ægialia, Latr. (having the body short, thorax transverse and abdomen gibbous, and composed of [a single small British species, found upon our sandy coasts.] *Ps. arenarius*, Gyll., &c.) and

Chiron, Mac Leay, (*Diasomus*, Dalm.), having the body narrow, long, and subcylindric, [and consisting of several exotic species, and placed by Mac Leay amongst the Lucanidæ], are both distinguished by having only nine joints in the antennæ; the others have eleven joints, which are, however, sometimes difficult in computation, the joint preceding the club being sometimes apparently confounded with the basal joint of the club.

Lethrus differs from the rest in having the club obconical and the mandibles exposed, very large, serrated internally, and with a large tooth in the males. *Lethrus cephalotes*, Fabr., according to Fischer, is destructive to young buds and leaves, which it bites off, whence, in Hungary, it is called "the Schneider," and where it does much injury to the vines, crawling backwards, with its food in its jaws, into its hole, each of which is occupied by a male and female; but in the pairing time a strange male sometimes intrudes, when a battle ensues which only ends in the death or flight of the stranger.

The others have the joints of the club of the antennæ of the ordinary form, and leaf-like.

Geotrupes, Latr., has the labrum advanced and transversely square, the jaws are curved and very compressed, and with the club of the antennæ oval or ovoid, the anterior tibiæ long and multidenticulate, and the clypeus lozenge-shaped: *Scarabæus stercorarius*, Linn., [the common *Dor*, or *Shard-borne Beetle*. One of the commonest British insects; there are several others, natives of this country.] Those species which have the thorax of the males cornuted form the [genus *Typhæus*, Leach], *Ceratophyus*, Fischer. Type, *Scarabæus typhæus*, Linn., [or the common English Bull-comber].

Fig. 69.—Geotrupes stercorarius.

Ochodæus, Meg., has the labrum strongly notched, the mandibles elongate, triangular, and the fore-tibiæ with only two teeth on the outer edge. *Melolontha chrysomelina*, Fab. [Germany].

Those species with the club of the antennæ large, orbicular, or subglobose, the middle joint being encased between the two outer ones, form three subgenera.

Athyreus, Mac Leay, approaches the Coprophagi in having the middle feet wider apart than the others.

Elephastomus, Mac Leay, has the clypeus produced into a thick, square horn, furcate at tip, and the maxillary palpi very long. *Scarab. proboscideus*, Schr. [New Holland].

Bolbocerus, Kirby (*Odontæus*, Zeigl.), has one of the mandibles simple, and the other bidentate at the tip; the maxillary palpi scarcely larger than the others. *S. mobilicornis*, Fabr., a small [rare British species, the male of which has a long erect horn on the head].

Hybosorus, Mac Leay, (having the basal joint of the antennæ obconical and elongated, the tibiæ narrow and elongated), and

Acanthocerus (having the basal joint of the antennæ very large, dilated above, and the tibiæ lamellar and concealing the tarsi), have ten joints in the antennæ, the last joint of the palpi elongate, and the mandibles not or but slightly toothed. The species of both are very small [and exotic].

In the second division of the Arenicoli, or the *Trogides*, the antennæ are always composed of ten joints, the labrum and mandibles but slightly exposed, the maxillæ armed with teeth; the body is dingy-coloured, and tubercular above; their fore-legs are advanced, their thighs covering the head beneath. These insects produce a stridulation by the action of the mesothorax against the sides of the prothoracic cavity.

Trox, Fabr.—These insects are found in the earth or sand, where they appear to devour the roots of vegetables. [*Trox arenarius* and two other British species, of small size.] Mr. Mac Leay has separated the apterous species with the sides of the thorax dilated, under the name of *Phoberus*.

Cryptodus and *Mæchidius*, Mac Leay, have the extremity of the body not covered by the elytra, and nine joints to the antennæ: Mæchidius appears to me to approach the Melolonthæ. [Mr. Mac Leay has subsequently discovered that Cryptodus belongs to the Cetoniidæ. Both subgenera are Australian.]

A third section, *Xylophili*, (*Geotrupes* and certain *Cetoniæ*, Fabr.), has the scutellum distinct, the extremity of the abdomen not covered by the elytra, the claws of the tarsi often unequal, the antennæ always 10-jointed, the last three forming a leaf-like mass, the middle leaf never being entirely concealed by the outer ones; the mandibles horny as well as the maxillæ, which are straight and often toothed. All the feet are inserted at equal distances apart. [This section comprises two divisions, corresponding with the families *Dynastidæ* and *Rutelidæ*, Mac Leay.]

The first division (comprising the *Geotrupes* of Fabricius) comprises those species, the males of which

differ from the females in being armed with peculiar horns or tubercles either on the head or thorax; the labrum is generally entirely concealed; in some species the maxillæ are terminated by a simple coriaceous or crustaceous lobe, without teeth; in others they are scaly, pointed, and armed with a few teeth; the sternum is not prominent; the tarsal ungues are generally equal, the colours generally black or brown.

Oryctes, Illig. (having the legs scarcely differing in length, with the four hind tibiæ thick and toothed, [a very numerous genus]—type, *Scar. nasicornis*, Linn., a reputed British species, 1½ inch long, the male having a curved horn on the head,) and *Agacephala*, Mann. (having the fore-legs in the male considerably elongated, and the four posterior tibiæ slender, and comprising a few Brazilian insects), differ from the following in having the maxillæ terminated by a coriaceous lobe without teeth. The others have them horny, and more or less toothed.

Scarabæus proper (*Geotrupes*, Fabr.), has the body very thick, and the outside of the mandibles sinuated o. toothed. The equatorial countries of both hemispheres produce some very remarkable species.

[Mr. Mac Leay, considering that the name *Scarabæus* ought to be retained for the sacred Scarabæi, or the Ateuchi of this work, and that the name *Geotrupes* ought to be given to the species which strictly merit that name, from their habits of burrowing into the ground, has proposed the name of *Dynastes* for these giant beetles here described under the name of Scarabæus. Mr. Kirby has further separated some species, especially in his manuscripts presented to the Entomological Society, founded upon the structure of the mouth, and which Mr. Hope has made use of in his *Coleopterist's Manual*, part i., in which many new genera are described and illustrated, with figures mostly drawn by me from Mr. Kirby's own dissections, so that the observation of Latreille, that the study of this group, in respect to the structure of the mouth, has not been sufficiently profound, is no longer to be made. The species are very numerous; one of the largest is]

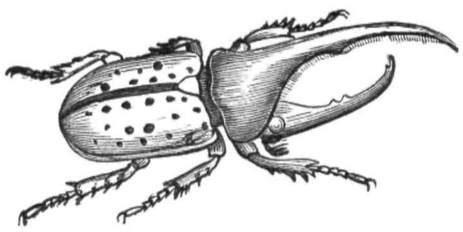

Fig. 70.—Scarabæus hercules.

Scarabæus hercules, Linn.—Five inches long; from South America, black, with grey elytra spotted with black.

Phileurus, Latr., has the body depressed, and the mandibles narrow, without teeth on the outside. [Composed of exotic species.]

Our second division [*Rutelidæ*, Mac L.] is nearly allied to the preceding in some respects, and also to the Melolonthæ and some Cetoniæ, of which they have the appearance, but the mouth is different. The body is shorter, rounder, and more polished than in the Scarabæi, and ornamented with brilliant colours. The head and thorax are identical, and not cornuted in either sex; the maxillæ are scaly, truncated at the tip, with five or six strong teeth. The mesosternum is often porrected, the scutellum large, and the tarsal claws unequal-sized. With few exceptions, they are confined to the equatorial regions of the New World.

Hexodon, Oliv., has the mesosternum simple, the body sub-orbicular, depressed, legs slender, and tarsal claws minute and equal. [Composed of two African species.]

Cyclocephala, Latr. (*Chalepus*, Mac Leay), has the sternum also simple, the body ovoid, the tarsal claws unequal. Numerous South American species. In the following the sternum is advanced between the middle feet.

Chrysophora, Dej., has the hind legs of the males enormously dilated and elongated. *Scarabæus macropus* [Francillon, from South America].

Rutela, Latr. (and *Pelidnota*, Mac Leay, *Oplognathus*, Kug.), has the feet not remarkably differing in the sexes the scutellum small, or moderate.

Macraspis, Mac Leay, differs in having a greatly developed scutellum, and the mandibles nearly triangular.

Chasmodia, Mac Leay, has a large scutellum and sternal point, but the mandibles are narrow, and obtuse at the tip: all the tarsal claws are entire.

Ometis, Latr., differs from the above in having the epimera developed between the hind angles of the thorax and shoulders of the elytra.

The genus *Melolontha*, of Fabricius, constitutes our fourth and fifth sections.

The fourth section (*Phyllophaga*), is formed of Scarabæides, nearly allied to the last described sub-genera, but the mandibles are concealed above by the clypeus, and beneath by the maxillæ, the outer edge being alone exposed; they are destitute of any sinus or tooth on the outside; the number of joints in the antennæ varies from eight to ten, that of the club also varies, and, in this respect, the sexes often differ; the elytra are united along the whole length of suture.

[This section comprises Mac Leay's two families, *Anoplognathidæ* and *Melolonthidæ*.]

The first division (*Anoplognathides*) has the clypeus thickened in front, forming alone, or with the labrum, a vertical triangular face, the point of which is applied to the mentum; the maxillæ of some are terminated by a coriaceous or membranous lobe, very long, and without teeth, or having but very small ones, and situated near the middle of the internal margin; in others they are entirely horny, resembling mandibles either entire at the tips, or terminated by two other teeth.

Pachypus, Dej. (the males of which have only 8 joints in the antennæ, the club being 5-jointed, *P. excavatus*) [South of Europe], and

Amblyterus, Mac Leay (having the antennæ 10-jointed, the club being 3-jointed), have the mentum nearly ovoid and very hairy, and the maxillæ terminated by a triangular hairy lobe, without teeth, or with very small ones.

Anoplognathus, Mac Leay, (and *Repsimus*, Leach), have a sternal point, the claws of the tarsi entire and unequal in size, the antennæ 10-jointed. [These are splendid Australian insects, with bronzed bodies, apparently of very common occurrence, from the numbers brought to England.]

Leucothyreus, Mac Leay, has the antennæ 10-jointed, one of the tarsal claws entire and the other bifid; the anterior tarsi are dilated, and spongy beneath in the males. [Brazilian insects.]

Apogonia, Kirby, differs in having all the tarsal claws bifid. [Exotic species of small size.]

Geniates, Kirby, has the antennæ 9-jointed, and the extremity of the maxillæ with three teeth, the mentum of the males with a beard, the claws as in Leucothyreus. *G. barbatus*, Kirby, (Brazil). *Melolontha obscura*, and others, appear to form a different subgenus, the tarsi not being dilated.

A second division of the Phyllophagi [called by mistake *Xylophiles* in the text], and which comprises the *Melolonthidæ* of Mac Leay, has the labrum transverse, with a notch in the middle; the mentum is as long as, or longer than broad, either nearly square or heart-shaped. The maxillæ are scaly, and mostly armed with five or six teeth. This division comprises two subdivisions, *Melolonthides* and *Hoplides*.

The *Melolonthides* have more than three plates in the club of the antennæ; the body is generally thick, mandibles robust, entirely, or for the greatest part, horny, the upper extremity strongly truncate, with two or three teeth, the labrum generally visible, the maxillary teeth robust, and all the tarsi have two claws.

Melolontha proper, has 10-jointed antennæ, the last five or seven in the males, and four or six in the females, form the club; the labrum is thick and deeply notched in the middle; the tarsal claws are equal; the abdomen is generally pointed at the end, at least in the males.

Melolontha vulgaris (*Scarabæus melolontha*, Linn.), [the common Cockchaffer,] is too well known to require description, and has formed the subject of elaborate anatomical works by Strauss Durckheim, Leon Dufour, and Chabrier. This insect (as well as another closely-allied species, *M. hippocastani*) [which last, however, is of very rare occurrence in this country] appear in certain seasons in so great abundance that they defoliate in a very short time large spaces of our forests and woods, devouring the leaves. The larva is also equally destructive to the roots of grass, &c., in our pastures and gardens, being a white grub [with a scaly head, six legs, and the body thick, fleshy, white, and curved, so that the creature ordinarily lies upon its side].

Rhisotrogus, Latr., differs only from Melolontha in having the antennæ 9 or 10-jointed, with the club 3-jointed. As it is not always possible to distinguish the number of joints immediately preceding the club of the antennæ, I reunite the genus Amphimallon, which I had first formed, and in which there are only nine joints in those organs. *M. solstitialis*, [the July Chaffer, a very common British species,] and others.

Ceraspis, Lep., Serv., has the hind margin of the thorax with two notches, the intermediate space forming a point; antennæ 10-jointed; tarsal claws, except the anterior, unequal; body clothed with small scales; consisting of a few Brazilian species, *C. pruinosa*, &c.

Areoda, Leach, has 10-jointed antennæ; the sternum pointed; all the tarsal claws equal in the supposed females, and unequal in the males. These are of brilliant colours. [*A. lanigera*, a handsome but common North American insect.] In all the following Melolonthides the antennæ have only nine joints. The four following have all the tarsal claws equal.

Dasyus, Lepel. and Serv., has the ungues of the two fore-feet, at least in the males, bifid, the others entire.

Serica, Macl. (*Omaloplia*, Dej.), has all the ungues bifid; the body ovoid, swollen, silky, with the thorax much broader than long. *S. brunnea* [a common British species of small size, mostly found in Spiders' webs].

Diphucephala, Dej., has all the tarsal claws bifid; fore-tarsi more or less dilated in the males; body narrow, and the front of the head deeply notched. [Small species of a shining green colour, proper to Australia; monographed by Waterhouse in *Trans. Ent. Soc.* vol. i.]

Macrodactylus, Latr., resembles the last in the length of the body, but the thorax is nearly hexagonal, and the tarsi alike in both sexes. Small insects, peculiar to the New World.

The remainder have the ungues of the middle tarsi alone unequal.

Plectris, Lep., Serv., has the largest of the middle ungues, and both in the other tarsi bifid.

Popilia, Leach, has the sternum advanced. [See Newman's Monograph of this genus, an abstract of which has appeared in the *Mag. of Nat. Hist.*]

Euchlora, Mac Leay (*Anomala*, Meg.), has no sternal point; one of the ungues of the four anterior tarsi is bifid in the males; body convex; clypeus short and transverse. [Latreille cites a species, *M. viridis* (which is the true type of *Euchlora*, of which group, confined to the Asiatic species, Mr. Hope has given a monograph in the *Proceedings of the Zoological Society*,) and also *M. Vitis, Julii, Frischii*, &c., which are retained as species of *Anomala* by English writers. The allied genus, *Mimela*, K.) has also been monographed by Mr. Hope in *Trans. Ent. Soc.* vol. i.]

Anisoplia, Meg., has also no sternal point, but the clypeus is narrow in front, with the extremity elevated. *M. horticola, agricola*, [British species].

Lepisia, Lepel. and Serv., have no sternal point, but the four anterior tarsi have both ungues bifid.

The *Hoplides* have the mandibles small, depressed, and apparently divided longitudinally into two parts; the inner membranous and the outer horny. The extremity is not sensibly toothed; the labrum is scarcely visible; the maxillæ have rarely only minute teeth; the two hind tarsi have generally only one claw.

Dicrania, Lepel. & Serv., have two ungues, alike, and bifid in all the tarsi; body polished; species inhabiting Brazil.

Hoplia, Illig., has but a single unguis to the hind tarsi; those of the other feet are unequal and bifid; the hind tibiæ are terminated by a coronet of minute spines; the body squamose. [*Hoplia argentea*, Oliv. *H. pulverulenta* is the only British species.]

Monocheles, Illig., differs from Hoplia in the clypeus being in form of a triangle, truncated in front; thighs of hind legs very robust; tibiæ short, with a strong curved spur.

The fifth section, *Anthobii*, is composed of species closely allied to the *Hoplides*, but having the two divisions of the lower lip produced considerably beyond the mentum, and the elytra gaping at the tips, which are rounded; the antennæ have nine or ten joints; the last three compose the club; the terminal lobe of the maxillæ is membranous, silky, and pencil-like, but leathery in others; the upper lip and mandibles are more or less solid as they are more or less exposed. These insects live upon flowers or leaves. [None of these insects are found in England; they chiefly inhabit the southern parts of Europe and the warm parts of both hemispheres.]

Some have the labrum and mandibles exserted, and two equal and entire claws in all the tarsi.

Glaphyrus, Latr. (having the inner edge of the mandibles toothed, the club of the antennæ ovoid, and the hind legs large), and

Amphicoma, Latr. (having the mandibles without teeth on the inner edge, and the club of the antennæ globular, and all the legs of ordinary size), have the basal joint of the club of the antennæ concave, and inclosing the others.

Anthipna, Esch., has the club of the antennæ composed of five leaflets.

The others have the labrum and mandibles covered or not exserted, and some at least of the ungues of the tarsi are bifid, and in some of these all the tarsi have two ungues.

Chasmatopterus, Dej. (having all the tarsal ungues bifid), and

Chasme, Lepel. & Serv. (having the larger unguis alone of the two posterior tarsi bifid), have the hind legs scarcely differing from the others, whilst in

Dicheles, Lepel. & Serv., the hind feet, at least in the males, have the thighs very thick and toothed; the tibiæ thick, and terminated by a strong claw.

Those which have but one unguis in the two posterior tarsi are *Lepitrix*, Lepel. and Serv., having nine joints in the antennæ, and the terminal lobe of the maxillæ very small—*Pachycnemus*, Lepel. & Serv. (with 10-jointed antennæ, the maxillary lobe long and narrow, and the elytra narrowed behind), and *Anisonyx*, Latr., having the elytra oblong, rounded behind, with the hind tibiæ subcylindric or elongate-conic.

The sixth and last section of the Scarabæides (*Melitophili*) is composed of insects having the body depressed, often of an oval form, brilliant, without horns, the thorax trapeziform or nearly orbicular; an axillary piece occupies in the majority the space between the posterior angles of the thorax and the shoulders of the elytra; the anus is not covered; the sternum is often prolonged into a point or advanced horn; the claws of the tarsi are equal and simple; the antennæ have ten joints, the last three of which form the club, always leafed. The labrum and mandibles are concealed, and in the form of flattened plates, entirely or partly membranous; the maxillæ are terminated by a hairy lobe like a brush, without horny teeth; the mentum is ordinarily ovoid, truncated above or nearly square, with the middle of the upper edge more or less concave. The larvæ live in old rotten wood: the perfect insect is found upon flowers, as well as on the trunks of trees, in places where the sap exudes, and which they greedily lap up.

This section is divisible into three principal divisions, which correspond to the genera *Trichius*, Fabr.; *Goliathus*, Lamarck; and *Cetonia*, Fabr., in its restricted state. The *Melitophili* of the two first divisions have not the sternum much porrected, and the lateral or axillary piece of the mesosternum (*Epimera*, Aud.) is not generally exposed above. Another character, which appears still more rigorous, consists in the labial palpi being inserted in lateral cavities on the anterior face of the mentum, th sides of the mentum extending behind them, and thus guarding them.

The *Trichides* have the mentum either nearly isometrical, or longer than broad, with the maxillæ exposed. This division comprises the single subgenus

Trichius, Fabr. [which has been cut up by Kirby, Gory, and others, into various minor subgenera]. *Trichiu nobilis*, Linn., and *T. fasciatus*, Linn. [are British species; the latter exceedingly rare]. The female of *T. hemipterus*, Linn., and some others from North America, are distinguished by having a long and slender horny insti u

ment at the extremity of the abdomen, with which they deposit their eggs. These species are commonly found on the ground, where they crawl about slowly. [They form the subgenus *Valgus* of Scriba.]

The second division, *Goliathides*, is distinguished by having the mentum much broader, covering the maxillæ.

Platygenia, Macl. (having the body very flat, the thorax subcordate, and the maxillæ terminated by a pencil of hairs), and

Cremastocheilus, Knoch (having the thorax transverse-quadrate, the maxillæ terminated by a strong tooth, with small spines; composed of several small curious exotic species), have the mentum concave in the middle, and the anterior extremity of the clypeus never cornuted nor toothed.

Goliath, Lam., Kirby, has the mentum without any discoidal concavity, emarginate at the top edge, and the anterior extremity of the clypeus of the males is divided into two lobes like truncated and obtuse horns. The thorax is nearly orbicular. This genus is composed of large and splendid species, from Africa and the East Indies. Some species from South America have been separated by St. Fargeau and Serville under the name of *Inca*, having the fore femora armed with a tooth. All the known species are of large size, but one sent from the Cape of Good Hope is not larger than *C. gagates;* the fore thighs are not toothed in the Goliathi, and the tibiæ have not a notch in the inside. An insect from Java, considered as a Goliath by Serville and St. Fargeau, has all the characters of *Cetonia*, only the thorax is rounder, and the male has a forked horn on the head. [This is the *Goliath rhinophyllus*, Weid. These splendid insects have recently attracted considerable interest in this country, several of the gigantic African species having been received by several Entomologists. Mr. Hope, in the *Coleopterist's Manual;* Mr. Mac Leay, in his Memoir on the *Cetoniidæ;* Messrs. Waterhouse and White, in the *Mag. of Nat. History*, as well as myself in the new edition of Drury, have described various species, or distributed them into subgenera. Various new species have also recently been described by the French Entomologists.]

The third division of the Melitophili, named *Cetoniides*, [thus named, although not corresponding with the *Cetoniidæ* of Mac Leay, as stated in the text,] has the sternum more or less prolonged into an obtuse point between the second pair of legs; the axillary piece is always visible above, occupying the space between the posterior angles of the thorax and the shoulders of the elytra; the thorax ordinarily triangular, but truncated in front; the mentum never transverse; its front edge more or less notched in the middle; the maxillary lobe is pencil-like; the body is nearly ovoid, and depressed.

Gymnetis, Mac Leay, has the hind margin of the thorax produced over the scutellum: the New World produces several species. Others, from Java and other parts of the East Indies, have the thorax elongated in the same manner, but not entirely covering the scutellum, and the clypeus is more or less bifid. Other species, from the East Indies or New Holland, with the clypeus similarly bifid, or armed with two horns in the males, the abdomen nearly triangular, and the club of the antennæ very elongate, compose the genus *Macronata* of Wiedemann; but all these groups will possess no solidity until the numerous species of the genus *Cetonia* have been investigated.

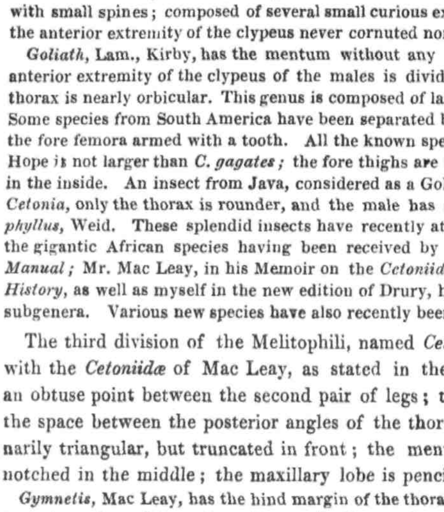

Fig. 71.—Cetonia aurata.

The European species possess a scutellum of the ordinary size.

Cetonia aurata, Linn.—Nearly an inch long; of a shining-green colour above, coppery-red beneath, with white marks on the elytra; [is one of our commonest insects, frequenting flowers, especially those of the Rose, whence its common name, the Rose-beetle. It is here figured with its larva, pupa, and cocoon, formed of small particles of chips, &c.]

[The splendid *Monographie des Cétoines* by Messrs. Gory and Percheron, although not sufficiently precise either in its structural details or bibliographical references, is indispensable to the student, as well as Mr. Mac Leay's Memoir on the *Cetoniidæ*, in Dr. Smith's work on the African animals collected by him; Mr. Hope's *Coleopterist's Manual*, and the general works on insects recently published, must also be consulted for descriptions of many new species, as well as genera, of Lamellicorn Beetles. The larvæ of this tribe have also been admirably illustrated in an anatomical Memoir by De Haan, published in the *Mémoires Nouvelles du Muséum d'Hist. naturelle.*]

The second tribe of Lamellicorn Beetles, the

LUCANIDES,—

So named after the Linnæan genus *Lucanus*, or Stag-beetles, has the club of the antennæ composed of teeth arranged perpendicular to the axis, like a comb; they are always 10-jointed, the basal joint being mostly very long, [the second being so inserted as to form an elbow with the preceding]; the

mandibles are always horny, often very much porrected, largest, and very diversified in form in the males. The maxillæ are commonly terminated by a long, narrow, hairy lobe, but in some they are entirely horny, and toothed : the tonguelet consists of two small hairy setæ extending beyond the .arge horny mentum ; the fore-legs are often elongated, with the tibiæ externally denticulated ; the tarsi are terminated by two equal and simple claws, with a small appendage between them, terminated by two bristles ; the elytra entirely cover the body.

We divide them into two sections, the first of which has the antennæ strongly elbowed, naked ; labrum very small, united to the clypeus ; maxillæ terminated by a membranous or coriaceous lobe, very hairy like a pencil, without teeth, or with only one ; the tonguelet either entirely concealed, or incorporated with the mentum, or divided into two narrow, long, hairy lobes : this section forms the genus

LUCANUS.

Those which have only three or four joints in the club of the antennæ form a first division.

Sinodendron, Fab., has a strong resemblance to Oryctes: the body nearly cylindrical, the mandibles hidden, without teeth, and alike in both sexes; the head of the males has an erect horn. *Scarabæus cylindricus*, Linn., a common British insect. Those with the body convex, ovoid, and the mandibles elevated vertically, and shorter than the head, form two subgenera,—

Æsalus, Fab. (having the body short and convex, the mandibles terminated above in a horn, and the maxillæ covered by the mentum, composed of a single European species, *Æs. scarabæoides*, Fabr.), and

Lamprima, Latr. [composed of splendid metallic Australian insects, *Lethrus æneus*, Fabr., &c.], with the body more elongated, the mandibles much longer than the head in the males, and very much toothed and hairy within. Those with the body flatter, especially in the females, the mesosternum prolonged and advanced, and head narrower than the thorax, are

Ryssonotus, Mac Leay, having the mandibles of the males formed as in Lamprima, comprising a single Australian species, *Lucanus nebulosus*, Kirby, and

Pholidotus, Mac Leay (*Chalcimon*, Dalm.), with the mandibles of the males greatly elongated, narrow, curved, and serrated on the inner edge. *Lamprima Humboldtii*, Schonh., and a few other beautiful species from South America.

[The magnificent genus *Chiasognathus*, Steph., is closely allied to the last. It is composed of a large and splendid species found in the Island of Chiloe, on the west coast of South America. Another species has been recently discovered on the Continent of America.]

In the following, the mesosternum is not pointed, and the head is as wide as, or wider than the thorax.

Lucanus proper, having the eyes not divided by the sides of their head, the body depressed, and the maxillæ terminated by a very long lobe.

Lucanus cervus, Linn., the common Stag-beetle, is one of our largest insects, the males being two inches long, or even longer, with the mandibles very large, curved, and toothed (like stag-horns) ; the females have the head narrower and the jaws smaller ; the size of this species and of its horns varies considerably. This insect flies abou in the evening in the middle of the summer, [especially round the oaks], upon the wood of which the larva feeds, remaining in that state for several years before undergoing its final transformation. It is supposed that this larva was the Cossus of the Romans, a worm-like animal, which they esteemed as a delicious treat.

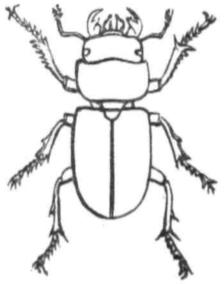

Fig. 72.—Dorcus parallelipipedus.

I unite the *Ceruchus* and *Platycerus* of Mac Leay, to Lucanus.

Platycerus, Latr. [*Dorcus*, Mac Leay], has the eyes entirely divided transversely by the margins of the head ; the maxillæ are terminated by a shorter and broader lobe. *Lucanus parallelipipedus*, Fab. [the small Stag-beetle, commonly found in England]. I also reunite to Platycerus the *Nigidius*, *Ægus*, and *Figulus* of Mac Leay.

Syndesus, Mac Leay, differing from all the preceding in having the club of the antennæ composed of the last seven joints. *S. cornutus*, Fab. [New Holland].

[*Hexaphyllum*, Gray, is a Brazilian genus, closely allied to Syndesus in the antennæ.]

The Lucanides of our second section have the antennæ but slightly elbowed and villose ; the labrum always exposed, horny, and transverse the mandibles robust, and very much toothed ; without remarkable sexual disproportions ; maxillæ entirely horny, with at least two strong teeth ; the tonguelet also horny, and situated in a notch of the mentum, and terminated by three points. The abdomen is attached by a peduncle, which has the scutellum on its upper part. These insects compose the genus

PASSALUS,—

Which Mac Leay restricts to the species with the club of the antennæ 3-jointed, the maxillæ armed with three teeth at the tip, and two on the inside. The species with a 5-jointed club to the antennæ, and with only two teeth to the maxillæ, compose his genus *Paxillus*. He also places in this same family the genus *Chiron*, which we have placed amongst the coprophagous Lamellicornes. These insects are strangers to Europe and also Africa, being

confined to the eastern countries of Asia, and particularly to America; Madame Merian says that the larva of the species she figured feeds upon the roods of the batatas: the perfect insect is not rare in sugar grounds.

[Eschscholtz, Sadovski, and Percheron, have recently published monographs of the genus Passalus. Mr. Hope has described various new species of Lucanidæ in the *Trans. Zool. Society*, vol. i., *Coleopterist's Manual*, &c. I have also described some new genera and species in the *Annales des Sciences Naturelles*, vol. i., and in the *Entomol. Magazine*, No. 23.]

The second general section of the Coleoptera, named HETEROMERA, has five joints in the four anterior tarsi, and one joint less in the two hind tarsi. These insects entirely subsist on vegetable substances, and are divided by us into four great families, the two first of which, in respect to certain portions of their internal organization, have some analogy with the first of the pentamerous Beetles. Some of the Heteromera have the elytra generally hard, the tarsal claws almost always simple, the head ovoid or oval, capable of being posteriorly received into the thoracic cavity, or sometimes narrowed behind, but never forming a sudden neck at its base: many of them avoid the light. This division comprises the three following families, [*Melasoma, Taxicornes,* and *Stenelytra*].

THE FIRST FAMILY OF THE COLEOPTERA HETEROMERA,—

THE MELASOMA,—

Is composed of insects of a black or ashy colour, and unvaried, whence the name of the family; they are for the most part apterous, with the elytra often soldered together; the antennæ entirely or partly moniliform, nearly of equal thickness throughout, or slightly thickened at the tip, inserted beneath the produced margins of the head, and having the third joint generally elongate; the mandibles bifid or notched at the tip; and having also a horny tooth at the inner edge of the maxillæ; all the joints of the tarsi are entire, and the eyes oblong and but slightly elevated, which, according to Marcel de Serres, indicates their nocturnal habits. They live for the most part in the ground, beneath stones, or in the sand; often also in low and dark parts of buildings, such as cellars, stables, &c.

The adipose tissue of these Heteromera is so much more abundant than in the following, that even when stuck upon a pin they are able to live nearly six months without food, as I ascertained in some specimens of Akis.

We divide this family, which corresponds with the genns *Tenebrio* of Linnæus, from the absence or presence of wings. Amongst those which are destitute of these organs, a first tribe, *Pimeliariæ*, is composed of those which have the palpi subfiliform, and not terminated by a distinctly hatchet-shaped joint. This tribe is named from the very numerous genus,—

PIMELIA, Fabr.

[None of the species are found in this country.]

Pimelia proper, consists of species peculiar to the shores of the Mediterranean, Western and Southern Asia (except India), and Africa, which have the body more or less oval, with the thorax narrower behind than the elytra; the front margin of the head straight, without a tooth in the middle, or a deep notch for the reception of the antennæ; the two terminal joints of the antennæ distinct, and the mentum more or less heart-shaped. M. Fischer has divided the species into three genera, but the characters do not appear to be sufficiently marked. A very remarkable species,—

P. coronata, is peculiar to Upper Egypt, where it is found in the tombs; it is about an inch and a half long, black, with a row of short spines bent backwards along the edges of the elytra.

Trachyderma, Latr., consists of Pimeliæ with a narrower abdomen.

Cryptochile, Latr., differs in their shorter form, with the mentum concealed by the prosternum. They are peculiar to the southern extremity of Africa.

The three following subgenera differ from Pimelia in having the body short, gibbous above, with the thorax short, and as broad behind as the elytra.

Erodius, Latr., has the last two joints of the antennæ united into a small club, the body generally swollen, and the fore tibiæ with a spur in the middle.

Zophosis, Latr., has the antennæ nearly filiform, or slightly thickening to the tip, with the tenth joint distinct from the preceding, and the third scarcely larger than the second.

Nyctelia, Latr., differs from the last in the much greater length of the third joint of the antennæ. The species are from South America, whilst those of Erodius and Zophosis are found in the Old World.

Hegeter, Latr. (having the thorax trapeziform), and

Tentyria, Latr. (with the head rather broader than the thorax, and antennæ longer than in Akis), are separated

from the preceding in having the head more or less narrowed in front, the middle of its great margin having a notch to receive the upper lip; the antennæ are always 11-jointed, and the thorax cordate-truncate.

Eurychora, Thunberg (with the body oval, the edges acute and ciliated), and

Adelostoma, Duponch. (with the body narrow and elongated), differ from all the foregoing in having the front edge of the mentum slightly emarginate, (not divided into two lobes,) or concave, with the lateral angles acute.

We terminate the *Pimeliaires* with such as have the mentum square, without any notch or impression in the front edge; the body is always oblong, the antennæ have always eleven distinct joints, the anterior femora are often thickened, and sometimes toothed.

Tagenia, Latr. (having the third joint of the antennæ scarcely longer than the following, and the eleventh very small), and

Psammetichus, Latr. (with the third joint of the antennæ much longer than the following, and the last joint as large as the preceding), have the thorax narrow, and the sides of the head dilated.

Scaurus, Fabr., with the thorax nearly isometrical, or square, composed of Old World species.

Scotobius, Germar, has the thorax broader than long, with the sides rounded; composed of South American species.

Sepidium, Fabr., has the sides of the thorax angular, or with a strong tooth, and the middle of the back is channelled; the sides of the head are but slightly dilated. The species are found in the South of Europe and Africa.

The two last genera have the antennæ composed of nearly cylindrical joints, the three or four terminal joints alone being rounded or ovoid; the species are inhabitants of the Cape of Good Hope.

Trachynotus, Latr., has the eyes round or oval, and the thorax depressed.

Moluris, Latr., and *Psammodes*, K., have the eyes narrow and long, and the thorax convex.

The second tribe of the Melasoma, that of the *Blapsides*, is named from the genus *Blaps*, Fabricius, in which the maxillary palpi are terminated by a joint evidently dilated like a hatchet or triangle. This tribe is formed of a single genus,—

BLAPS.

Those species which have the body generally oblong, with the sides of the abdomen embraced by the elytra, which are mostly narrowed behind, and the tarsi alike in both sexes, form a first division, some of which have the mentum small, occupying not more than a third part of the under-side of the head.

The four following subgenera have the tibiæ slender, without strong teeth, and the thorax is not dilated in front.

Oxura, Kirby, has the body long and narrow, and the thorax longer than broad.

Acanthomera, Latr., has the thorax nearly orbicular and transverse, and the abdomen nearly globular.

Misolampus, Latr., has the thorax nearly globose, and the abdomen nearly ovoid. [These three groups do not occur in England.]

Blaps, Fabr., has the thorax nearly square, flat, or but slightly convex; the abdomen oval, transversely truncate at its base; the elytra in many are narrowed into a point, especially in the males, and the third joint of the antennæ is longer than the following.

Fig. 73.—Blaps mortisaga.

Blaps mortisaga, Linn., is black, but little shining, and the tip of the elytra forms a short obtuse point. It is found in dark and dirty places about houses. [A very common British insect.]

Fabricius states that the Turkish women which inhabit Egypt, where *Bl. sulcata* is common, eat that species cooked with butter in order to make themselves fat. It is also said that it serves as an antidote against the ear-ache, and the sting of the Scorpion.

Gonopus, Latr., has all the tibiæ angular, the two anterior broad, and strongly toothed on the outside, and the thorax is dilated in front. [Exotic species.]

The other insects of this tribe, which have the feet alike in both sexes, differ in the large size of the mentum, which occupies the greater part of the under-side of the head in the form of a heart truncate behind.

Heteroscelis, Latr., has the outer edge of the four fore feet armed with two strong teeth, one in the middle and the other at the tip, and the body oval, rounded at each end.

Machla, Herbst., has the antennæ terminated by a small club, formed of the last three joints, and lodged in canals on the under-side of the thorax.

Scotinus, Kirby, has the antennæ terminated in a small club, but the last two joints are nearly united, and not lodged in canals. [These three subgenera consist of exotic insects.]

Asida, Latr., differs from the last three subgenera in having the thorax nearly trapezoid, and the mentum covers the base of the maxillæ.

In the remainder of the Blapsides, the body is oval and but little elongated, the lateral fold of the elytra is narrow and extends but slightly beneath, and the feet are unlike in the sexes, the two fore anterior tarsi being dilated in the males, the under-side being generally silky, or furnished with a brush. These insects inhabit sandy districts, the two fore tibiæ being generally broad and dilated triangularly, so as to be fitted for burrowing.

Pedinus, Latr., has the fore margin of the head always notched; the two anterior tarsi of the males are alone

evidently more dilated than the following. Megerle and Dejean have cut this up into several other subgenera, without, however, characterizing them. Such are their genera,—

Opatrinus (in which the males have the four basal joints of the anterior tarsi of equal breadth, composed of American species); *Dendarus*, Meg., in which the basal, and especially the fourth joint, are evidently narrower than the intervening joints, the tibiæ long and narrow, but little dilated at the tip; *Heliophilus*, Dej., in which the sides of the thorax are suddenly narrowed near the posterior angles; *Eurynotus*, K., with the thorax large, scarcely broader than long, and strongly margined; *Isocerus*, Meg., with the body distinctly more convex above, and the thorax transverse, and *Pedinus* proper, in which the males have the three basal joints of the two anterior tarsi always very much dilated, diminishing gradually in breadth, the fourth being very small; the hind thighs of the same individual are concave and silky beneath. [We possess a species of this genus found on the sea coast, of small size and black colour,—*P. maritimus*.]

Blapstinus, Dej. (with the front margin of the head notched,) and

Platyscelis, Latr. (with the head entire in front), have the four anterior tarsi of the males equally dilated.

We are now arrived at Melasomata furnished with wings, having the body generally oval or oblong, depressed, or but slightly elevated, with the thorax square or trapeziform, as broad behind as the abdomen; the palpi are largest at the extremity; the last joint of the maxillary palpi is hatchet-shaped; the mentum is but little extended in breadth, leaving the base of the maxillæ exposed.

These Melasomata compose the third and last tribe, that of the *Tenebrionites*, formed of the single genus

TENEBRIO,—

Such as it was at first formed by Fabricius, to which we reunite those which he has named *Opatrum* and *Orthocerus*. They serve as types for the same number of peculiar sections.

1. Those with the body oval, the thorax nearly trapezoid, curved at the sides or semi-oval, broader behind than the abdomen; the maxillary palpi terminated by a hatchet-shaped joint.

Crypticus, Latr., has the body convex and polished above, with the head exposed; the antennæ are nearly as long as the thorax; the tibiæ are long and narrow. Type, *Pedinus glaber*, Latr. [a species found in England on the sea coast, of a small size and black colour].

Opatrum, Fabr., has the body generally less elevated and often depressed, the head and eyes received into the deep prothoracic cavity; the antennæ are shorter than the thorax, the elytra are rough, the fore tibiæ are broad in some.

Silpha sabulosa, Linn., about one third of an inch long, of an ashy grey colour. Very common throughout Europe [including England] in sandy places, appearing in the first fine days of the spring.

2. Those with the body narrow and elongated, nearly of the same width or wider behind, with the thorax nearly square, and at least as long as wide, the antennæ forming a thick mass.

Corticus, Dej. (having cylindric antennæ), and

Orthocerus, Latr. (with spindle-shaped antennæ), have these organs thick, perfoliated, hairy, and apparently only 10-jointed; *Hispa mutica*, Linn. [The type of the last subgenus is found in sand pits in various parts of England.]

The antennæ of the others are of the ordinary thickness, not visibly perfoliated, and with ten distinct joints.

Chiroscelis, Lam., with the fore-tibiæ palmated. *Ch. bifenestra*, Lam., [a large African insect].

Toxicum, Latr., with simple fore-tibiæ, and with the head triangular, and thorax nearly square. [Exotic species of moderate size.]

Boros, Herbst., with simple fore tibiæ, and with the head oval, and thorax somewhat oval.

3. Those with the body long and narrow, the thorax nearly square, the antennæ of the ordinary size, and not suddenly terminated by a club; the thighs of the two fore-legs are thick, and the tibiæ bent and narrow.

Calcar, Dej., has the thorax oblong, the body linear, of equal breadth throughout, the front of the head notched.

Upis, Fab., has the thorax oblong, the body narrow but not linear, the front of the head straight. *U. cerambоides*, Fabr. [a German species].

Tenebrio, Linn., Fabr., differs only from Upis in having the thorax broader than long.

Tenebrio molitor, Linn., about two-thirds of an inch long, of a black brown colour, is of very common occurrence [in England], being found, especially in the evening, in unfrequented parts of houses, bake-houses, and corn-mills, &c. Its larva [known under the name of the Meal-worm] is long, cylindric, and of an ochre colour, scaly, and very smooth; it lives in barley and wheat [biscuits, flour, &c.] and is given to Nightingales. The Brazilian, *T. grandis*, is found under the bark of trees, and discharges from the anus a caustic fluid to the distance of a foot.

Heterotarsus, Latr., has the penultimate joint of all the tarsi minute, and received in a canal of the preceding joint.

[The student will find the descriptions of many new genera in this and the two preceding sections of Melasoma, described by M. Solier in the *Annales de la Société Entomologique de France*, and by M. Guérin in his *Magasin de Zoologie*, and in the *Voyage de la Coquille*.]

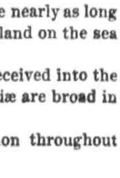

Fig. 74.—Tenebrio molitor.

THE SECOND FAMILY OF THE COLEOPTERA HETEROMERA,—

THE TAXICORNES,—

Have no corneous hook on the inner edge of the maxillæ; they are also furnished with wings; the body is often square; the thorax trapezoid or semicircular, and concealing or receiving the head; in some the antennæ, generally inserted beneath the produced margin of the sides of the head, are short, more or less perfoliated, gradually thickened, or terminating in a mass. The feet are fit only for running, and all the joints of the tarsi are entire, and terminated by simple hooks; the fore-tibiæ often broad and triangular; many males have the head furnished with horns. The majority of these beetles are found in fungi growing on trees, or beneath the bark; others live in the ground, under stones.

Some, forming the first tribe, *Diaperales*, have the head entirely exposed, and never entirely received in a deep notch of the front of the thorax, which is either trapezoid, square, or subcylindric, its sides like those of the elytra, not forming a decided margin to the body. This tribe has for its type the genus

DIAPERIS,—

Of which some have the antennæ thick, straight, and perfoliated or clavate.

Phaleria, Latr. (*Uloma* and *Phaleria*, Dej.), has the fore-tibiæ broad and triangular, the body ovoid, and the antennæ not terminated by a club. A numerous subgenus, divided by Dejean into several others, the type, *Tenebrio cadaverinus* [the only British species found on the coast], being retained as the type of Phaleria.

Diaperis proper, has the fore-legs narrow and nearly linear, with the maxillary palpi terminated by a subcylindrical joint. Type, *Diaperis boleti* [a handsome but rare British species], nearly one third of an inch long, black, with three dentate bands of orange on the elytra.

[The insects of this genus have formed the subject of a valuable monograph by Laporte and Brullé, in the *Annales des Sci. Nat.*]

Hypophlæus, Fabr., differs from the preceding in the linear form of the body. They are found under the bark of trees. *H. castaneus*, [a rare British species].

The three following have the antennæ terminated by an abrupt club, composed at least of four joints.

Trachyscelis, Latr., with the antennæ scarcely larger than the head, having a 6-jointed club; body thick, convex, and tibiæ broad and fossorial. [*T. Aphodioides*, a reputed British species of small size.]

Leioides, Latr. (*Anisotoma*, Illig.), differs in having the tibiæ narrow and spinose, club of antennæ 5-jointed. [A very numerous genus, of minute species.]

Tetratoma, Herbst., has the body longer, and the club of the antennæ 4-jointed. [*T. fenigorum*, and several other British species of small size, found in fungi.]

The antennæ in the others are curved, and terminated by a 5 or 3-jointed perfoliated club; the palpi filiform, the head of the males often cornuted. They are found in boleti growing on trees: they form the genus *Eledona*, Latr., *Boletophagus*, Fab.

Coxelus has the three terminal joints alone of the antennæ forming the club. (*C. spinulosus*.)

The second tribe of the Taxicornes, the *Cossyphenes*, is formed of species resembling, in the general form of the body, *Peltis*, *Nitidula*, and *Cassida*, being ovoid or subhemispherical, margined all round by the dilated edges of the thorax and elytra; the head entirely hidden beneath the thorax, or received into a very deep notch in the front of this part of the body; the maxillary palpi are hatchet-shaped. This tribe is composed of the genus

COSSYPHUS, Oliv.

Cossyphus proper, having the front of the thorax entire and produced over the head, (consisting of exotic species,) and

Helæus, Latr., with the head received in a deep frontal notch of the thorax, or exposed through a central aperture (composed of Australian species), have the body flattened and shield-shaped, whilst in

Nilio, Latr., it is nearly hemispherical, with the head also exposed. [Composed of exotic species, having much the appearance of Lady-birds.]

THE THIRD FAMILY OF THE COLEOPTERA HETEROMERA,—

THE STENELYTRA,—

Differs from the preceding only in the antennæ, which are neither moniliform nor perfoliated, and in which the tip is not generally thickened. The body is often oblong, arched above, with the feet long; the males closely resemble the females. These insects are generally much more active than the preceding; some are found under the bark of old trees, but many frequent the leaves and flowers; the greater number were united by Linnæus with the genus Tenebrio; but he arranged others with Necydalis.

Chrysomela, Cerambyx, and Cantharis. In the first edition of this work, I had united the whole into one genus, Helops, but their internal as well as external anatomy indicates that this family constitutes five tribes, composed of the same number of genera, namely, *Helops*, *Cistela*, *Dircæa*, Fabr., *Œdemera*, and *Mycterus*, Oliv. In respect to their digestive organs and other characters, Helops and Cistela approach Tenebrio; but the Cistelæ have the mandibles entire, and generally live amongst leaves and flowers, in which respect they differ from Helops; the majority of the Dircææ have the faculty to leap, and the penultimate joint of the tarsi is bifid in many. Some live in fungi, &c., and others in rotten wood. These are allied on one hand to Helops, and on the other to Œdemera, and especially to Nothus, belonging to the same tribe. Such are the principles upon which I have distributed this family.

Those which have the antennæ inserted near the eyes, and the head not produced into a long muzzle, form the first four tribes, [*Helopii*, *Cistelides*, *Serropalpides*, and *Œdemerites*].

The *Helopii* have the antennæ covered at the base by the margin of the head, nearly filiform, or slightly thickened at the tip; generally composed of nearly cylindrical joints, the terminal one being always the longest; the extremity of the mandibles is bifid; the last joint of the maxillary palpi is largest, and hatchet-shaped; the eyes oblong, and kidney-shaped: none of the legs are formed for leaping; the penultimate joint of the tarsi is either entire or not deeply bilobed; the ungues entire; the body often arched above, and of a solid consistence; the larvæ, so far as known, are filiform, smooth, and shining, with very short feet like those of the Tenebrionidæ; they are found in old wood; the perfect insects are also met with beneath the bark. This tribe nearly corresponds with the genus

HELOPS, Fabr.

Epitragus, Latr. (having the base of the maxillæ hidden by the mentum),

Cnodalon, Latr. (with the head narrower than the thorax), and

Campsia, Lepel. and Serv. (*Camaria*, L. & S., with the head as broad as the hind part of the thorax), are American groups, having the hinder extremity of the prosternum produced into a small point, received into a notch of the mesosternum. In all the other Helopii the mesosternum is not notched, nor the prosternum pointed.

Spheniscus, Kirby (Brazilian insects, having the appearance of Erotyli),

Acanthopus, Meg. (with the fore thighs thick and toothed, *A. dentipes*, Germany),

Amarygmus, Dalm. (with simple fore-legs and antennæ),

Sphærotus, Kirby (with the thorax narrower throughout than the abdomen, and with simple antennæ and slender tibiæ), and

Adelium, Kirby (being of an oval form, with the thorax nearly orbicular, composed of New Holland insects), have the body nearly ovoid or short, with the thorax transverse. [None of these subgenera occur in this country.]

Helops proper, has the thorax transverse, scarcely as long as wide, and closely applied to the base of the elytra. *H. cœruleus*, *lanipes*, and *caraboides*, [British insects, the last being exceedingly abundant].

Læna has the last joint of the antennæ thicker than the preceding, and ovoid, the thorax truncate-cordate, separated from the abdomen by a visible space; anterior femora thickened. [European species of small size.]

The following Helopii have the body long and narrow, the thorax nearly square, or truncate-cordate.

Stenotrachelus, Latr. (*Dryops*, Pk.), with the head narrowed behind into a neck, the three terminal joints of the antennæ short and thick. *D. ænea*, Payk. [a continental species].

Agnathus decoratus, Germar, appears to approach the last very closely, as does also *Pelmatopus Hummelii*, Fisch.

Strongylium, K., and *Stenochia*, K., have the head not narrowed into a neck, and the terminal joints of the antennæ scarcely differing from the preceding. [Brazilian insects, mostly gaily coloured.]

Pytho, Latr., has the body flattened and the thorax narrowed behind. [*P. depressus*, found in the north of Europe. The larva is very flat.]

The second tribe, *Cistelides*, is exceedingly close to the preceding, but the antennæ are not concealed at the base; the mandibles are entire; the tarsal ungues denticulated: many of these insects live in flowers. This tribe forms the genus

CISTELA, Fabr.

Lystronichus, Latr., has the thorax thick, narrow, and suborbicular. [Brazilian insects.]

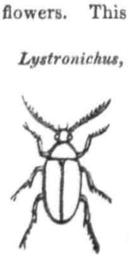

Fig. 75.—Cistela ceramboides

Cistela proper, has the thorax depressed trapezoid, the head produced into a short muzzle, the antennal joints mostly serrated, and the body ovoid or oval.

Cistela ceramboides, five lines long; black, with orange-coloured, striated elytra; the larva resides in the decomposed wood of the oak.

Mycetochares, Latr. (*Mycetophila*, Gyll.), has the head not produced into a muzzle, and the body narrow and elongated. *H. barbatus*.

Allecula, Fabr., differs from the preceding in having the penultimate joint of the tarsi bilobed, and the last joint of the maxillary palpi hatchet-shaped.

[M. Solier has revised this tribe, and added several new genera, in the *Annales de la Société Entomol. de France*.]

The third tribe, ***Serropalpides***, is distinguished by the maxillary palpi being serrated, very large, and drooping; the antennæ are inserted in a notch of the eye, often short and filiform; the mandibles are generally bifid at the tip, and the tarsal ungues simple; the front of the head is not produced, and the hind thighs are not thickened, in which they differ from the following; the penultimate joint of the tarsi, of the four fore-feet at least, is bilobed, and in those in which it is entire, the hind feet are fitted for leaping, being long, compressed, with slender tarsi. This tribe has for its type the genus—

DIRCÆA, Fabr.

Orchesia, Latr., differs from the rest in having the antennæ clavate, the maxillary palpi terminated by a hatchet-shaped joint, and the hind feet are formed for leaping. [*O. micans*, Latr., a minute British species.]

Eustrophus, Illig. (with the body ovoid, and the antennæ shorter than the thorax), and

Hallomenus, Payk. (with the body elongate oval, and the antennæ longer than the thorax), have the palpi but slightly thickened at the tip. The remainder have the body narrow and elongated, with the maxillary palpi hatchet-shaped, and some of these have the antennæ thick and short.

Dircæa proper (*Xylita*, Payk.), has the maxillary palpi not serrated, the antennæ thick, the body oval-shaped, and the scutellum very small.

Melandrya, Fabr., with the maxillary palpi evidently serrated, the thorax depressed at the sides, and the scutellum moderate-sized. [*M. caraboides*, a common British species.]

Hypulus, Pk., has the body narrow and nearly linear, with the thorax oblong and narrow behind. *D. quercinus*, [a very rare British species].

Serropalpus, Hellw., has the antennæ slender, subcylindric, the body of a firm consistence, and the maxillary palpi strongly serrated.

Serropalpus, Gyll., differs from the last in having the body soft, the maxillary palpi scarcely serrated, and the penultimate joint of the tarsi bilobed. [Two very rare British species.]

The fourth tribe, *Œdemerites*, is nearly allied to the preceding in the insertion of the antennæ, bifid mandibles, bilobed penultimate joint of the tarsi, and securiform maxillary palpi; but (with the exception of *Nothus*, which, although nearly allied to some of the preceding, differs in having the hind femora thickened) exhibits a series of characters which does not allow them to be confounded with any other Heteromera. The body is long, narrow, nearly linear, with the head and thorax rather narrower than the elytra; the antennæ are longer than these parts of the body, serrated in some, but composed of long cylindric joints in the others; the anterior extremity of the head is more or less produced into a short muzzle, with the eyes more prominent; the thorax is at least as long as broad, nearly square or cylindrical; the elytra are linear, narrowed behind, and often flexible. These insects are related to the Telephori and Zonites. They are found in flowers or trees; their metamorphoses are not known. They form a single genus,—

ŒDEMERA, Oliv.

Nothus, Zeigl. (*Osphya*, Illig.), has the antennæ short, simple, and inserted in a notch in the eyes; the hind thighs thickened in one sex, the thorax as broad as the base of the abdomen, and the tarsal claws bifid. [*N. clavipes*, a very rare insect, found in Huntingdonshire.]

Rhæbus, Fischer, ought probably in a natural system to be placed here.

Calopus, Fab., has the antennæ very long and serrated, the hind legs simple, with the second joint very short. *C. serraticornis*, [a common continental species].

Sparedrus, Megerle, differs from Calopus in having the antennæ simple.

Dytilus, Fisch., has the antennæ also filiform, inserted in front of the eyes; the elytra are not narrowed at the tips. *D. helopioides*, [a continental species].

Œdemera, Oliv., has the hind legs thickened in one sex, the antennæ long and slender in one sex, and the elytra very much narrowed at the tips. [*Œd. cærulea*, a very common British insect. Several of the species have been separated as distinct subgenera by Stephens.]

The fifth and last tribe of the Stenelytra, that of the *Rhyncostoma*, is composed of insects some of which are nearly allied to the Œdemerites, whilst the others appear to belong in a natural order to the family of the Weevils (*Rhyncophora*). The head is evidently prolonged in front, in the shape of a muzzle or flattened rostrum, having the antennæ at its base and in front of the eyes, which are always entire. These insects form a single genus

MYCTERUS,—

Some of which have the antennæ filiform, and the muzzle not dilated at the tip.

Stenostoma, Latr. (*Leptura*, Fabr.), has the body narrow, the thorax conical, truncated, the elytra flexible, narrowed to a point. *Œd. rostrata*, Latr., [South of Europe].

Mycterus, Clairv., has the body ovoid, solid, silky, [with the elytra entire]; the antennæ appear to be 12-jointed. [*M. griseus*, a continental species.]

Rhinosimus, Latr. (*Salpingus*, Illig.), has the antennæ terminated by an elongated mass, formed of three or five joints; the muzzle very flat, with a produced angle on each side before the tip. They reside beneath the bark of trees, and require in a natural order to be arranged near to *Anthribus* of Fabricius, by whom indeed they were united therewith. The body is depressed and the palpi thicker at the tips. [*S. roboris*, a pretty minute British species.]

Our second general division,—

THE FOURTH FAMILY OF THE COLEOPTERA HETEROMERA,—

THE TRACHELIDES,—

Have the head triangular or heart-shaped, carried on a kind of neck, which, being as wide as the front of the thorax, prevents it from being immersed therein up to the eyes; the body is often soft, with the elytra flexible, not striated, and often very short, one partially lapping over the other; the maxillæ are never hooked; the tarsal joints are entire, and the ungues bifid. The majority live in the perfect state upon different vegetables, devouring the leaves or sucking the honey of the flowers: many, when seized, depress the head, and contract the feet, as if they were dead; others are very active.

We divide this family into six tribes, forming the same number of genera. The first tribe, *Lagriariæ*, has the body elongated, narrower in front than behind, with the thorax either subcylindric or square, or ovoid and truncated; the antennæ inserted near a notch of the eyes, simple, filiform, or thickened gradually to the tips; generally moniliform, with the last joint longer than the preceding in the males; the palpi thickened at the tips, and the last joint of the maxillary palpi long and triangular; the tibiæ long and narrow; the two anterior curved; the penultimate joint of the tarsi bilobed, and the ungues neither bifid nor toothed. The indigenous species inhabit woods, and are found upon different vegetables; the body is soft, the elytra flexible, and, like the Cantharides and Meloes, they feign death when taken.

Lagria proper, is composed of species which have the antennæ gradually thickened, and partly or entirely moniliform, the last joint ovoid or oval, the head scarcely advanced in front, and the thorax subcylindric or square. [*L. hirta*, a very common British insect, of small size; found in hedges, in which also I have found its larvæ, which is hairy, with the extremity of the body bifid.)

Statira, Latr., is formed of exotic species resembling the genus Agra; prolonged in front, and suddenly narrowed behind the eyes.

Hemipeplus, Latr., doubtfully belonging to this tribe, has the antennæ filiform, short, and elbowed, the body linear and depressed, and the head heart-shaped.

The second tribe, *Pyrochroides*, approaches the preceding in respect of the tarsi, the length and slenderness of the anterior part of the body, which is however depressed, with the thorax nearly orbicular or trapezoidal; the antennæ, at least in the males, are pectinated or feathered; the maxillary palpi are but slightly serrated, and terminated by a subsecuriform joint; the labial filiform; the abdomen elongate, entirely covered by the elytra, and rounded behind. They are found in the spring in woods, the larvæ living beneath the bark of trees; they form the genus—

PYROCHROA, Geoffr.

Dendroides, Latr., has long feathery branches to the antennæ. (Exotic species.)

Pyrochroa proper, has the antennæ simply pectinated. [*Pyrochroa rubens*, a very abundant British species, of a scarlet colour, with black legs and antennæ.]

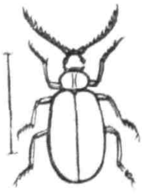
Fig. 76.—Pyrochroa rubens.

The third tribe, *Mordellonæ*, although not distinguished by any constant character, derived from the tarsi, ungues, antennæ, or palpi, is easily to be distinguished by the general form of the body, elevated and arched, with the head low, the thorax trapezoid or semicircular, the elytra very short, or narrow and pointed at the tips, as well as the abdomen. In their antennæ, many approach the Pyrochroides; others, in their maxillæ, ungues, tarsi, and parasitic habits, are allied to Nemognathæ and Sitaris, subgenera of the last tribe of this family, but they are removed from both by their extreme agility, and the firm texture of their integuments. They form the genus—

MORDELLA, Linn.

Some have the palpi of unequal thickness throughout, the antennæ of the males strongly pectinated or fan-shaped, the extremity of the mandibles not notched, and the tarsal ungues denticulated.

Ripiphorus, Bosc., has the wings extended beyond the elytra, which are as long as the abdomen; the tarsal ungues bifid; the antennæ strongly *bi*pectinated in the males, *uni*serrated in the females. Some naturalists have found in the nests of the common Wasp, many living individuals of the [English species], *Ripiphorus paradoxus* which has been thence inferred to be parasitic in the larva state in such situations. Nevertheless, from an obser-

vation of M. Farines, the larva of the two-spotted Ripiphorus lives and undergoes its changes in the stalk the *Eryngium campestre*.

Myodites, Latr. (*Ripidius*, Thunb.), has the wings also extended, but the elytra are very short; the antennæ ar very strongly feathered; the tarsal claws are toothed.

Pelecotoma, Fisch., has also the tarsal claws toothed, but the wings [and abdomen] are entirely covered by the elytra. [Exotic insects, of moderate size.] In the others the palpi are terminated by a large hatchet-shaped joint; the mandibles are bifid at the tips, and the antennæ of the males are only serrated.

Mordella, Linn., has the antennæ of equal thickness throughout, and slightly serrated in the males; the eyes are not emarginate, [and the abdomen is terminated by a long point. *M. aculeata*, Linn., and many other small British species].

Anaspis, Geoffr., has the antennæ simple, and rather thickened to the tips, the eyes notched, [and the abdomen not pointed]. *A. frontalis* [and numerous other minute British insects].

The fourth tribe, *Anthicides*, possesses simple or but slightly serrated and filiform antennæ, or but little thickened at the tips; the joints very nearly alike, except the last, which is rather longer, and oval; the maxillary palpi are terminated by a hatchet-shaped joint; the penultimate joint of the tarsi is bilobed; the body narrower in front, with the eyes entire or scarcely emarginate. Some of these species are found upon plants, but the majority live on the ground, and run with great quickness: their larvæ are probably parasites. They compose the genus,—

NOTOXUS, Geoffr.

Soraptia, Latr., has the thorax nearly semicircular, and the antennæ inserted in a notch of the eyes, filiform. They have a great analogy with Mordella, Cistela, &c., in their form. (*S. fusca*, a minute British species.)

Steropes, Stev. (*Blastanus*, Illig.), has the antennæ terminated by three long joints.

Notoxus proper, has the antennæ gradually thickened, the joints conical, and the thorax of a reversed ovoid form, narrowed, and truncated behind, or divided into two globose knots. Some species [to which English Entomologists restrict the name *Notoxus*], have the thorax produced into a horn over the head. *N. monoceros*, Linn. [a small British species found in sand banks]. Those with the thorax unarmed [form the restricted genus *Anthicus* of English authors. *A. fuscus*, and many other minute species], some of which are apterous.

The two following tribes, which terminate the Heteromera, have several characters in common: mandibles terminated by a simple point; palpi filiform, or but slightly thickened at the tips; abdomen soft; elytra flexible; possessing vesicatory powers; ungues generally bifid. In the perfect state, many of them are herbivorous; but many amongst them are parasites whilst larvæ.

The fifth tribe, *Horiales*, differs from the succeeding by having the ungues denticulated, and furnished with a seta; and the antennæ are filiform, not longer than the thorax; the labrum small; mandibles strong and exposed; palpi filiform; thorax square, and the two hind legs very robust, at least in one sex. The transformations of *Horia maculata* are described in the *Trans. Linn. Soc. of London*, [by the late Lansdown Guilding]. The larva destroys that of a large Carpenter Bee (*Xylocopa teredo*, which makes its nest in the trunks of trees in St. Vincents): this is effected, as the author supposes, by the larva of the beetle devouring the provisions laid up in store for the larva of the Xylocopa, which is of course starved to death. This tribe is composed of the genus—

HORIA, Fabr.,—

Species of which inhabit the intertropical parts of South America, and East India.

Cissites, Latr., has the head narrower than the thorax, and the posterior femora greatly thickened.

The sixth and last tribe, or the Vesicatory Beetles (*Cantharidiæ*), is distinguished from the preceding by the tarsal ungues, which are very deeply divided, so as to appear double; the head is generally large, broad, and rounded behind; the thorax is generally narrowed behind, approaching the shape of a truncated heart; in others it is nearly orbicular; the elytra are often slightly inclined at the sides; they counterfeit death when seized, and many at such times emit a yellowish liquid from the joints of the feet, which is caustic, and of a penetrating odour, the organs for the secretion of which have not been observed. Several species (*Meloe, Mylabris, Cantharis,*) are employed externally as vesicants, and internally as a powerful stimulant; the latter is however very dangerous in its application.

This tribe is formed of the genus—

MELOE, Linn.,—

Which has been divided into various others. The anatomical researches of Messrs. Léon Dufour and Bretonneau upon the epipastic powers of these insects, enable us to arrange these generic groups in a natural order, only slightly differing from that already adopted. The latter has discovered that Sitaris does not possess this property; it also resembles Zonitis in its general structure, and the latter are contiguous to Cantharis. These insects therefore

occupy one extremity of this tribe, whence it becomes easy from a comparative study of other relations, to pursue the series to the other extremity; this is also in accordance with the progressive changes of the antennæ.

Cerocoma, Geoff., has only nine joints in the antennæ of both sexes, those of the males being of a very irregular construction. The species appear towards the summer solstice in great abundance at the same place; they are found upon flowers, especially the wild chamomile. *N. Schäfferi*, Linn. [None of the species are found in England.]

Hycleus, Latr. (*Dices*, Dej.), has the two or three terminal joints of the antennæ united (at least in the females), into a thick ovoid mass, the number of joints being nine or ten. *Mylabris impunctata*, Oliv. [Exotic species.]

Mylabris, Fabr., has longer antennæ, with eleven distinct joints in both sexes, gradually terminating in a club; the eleventh or last joint being large and ovoid.

Megerle has separated some species, from the variation in the length of the intermediate joints of the antennæ, into the genus *Lydus*, some of which are better characterized by having one of the divisions of the ungues toothed.

Mylabris chicorii, Linn., inhabits the south of Europe, and its vesicatory properties are as powerful as the Cantharis of the shops, with which, no doubt, it is mixed in Italy. The Chinese use *M. pustulata*.

Œnas, Latr., has the antennæ not longer than the thorax, and of equal thickness throughout, with the last joint conoid.

Meloe, Linn., has the antennæ composed of short rounded joints, the middle ones being the thickest, and sometimes arranged so that these organs make a strong crescent in some males; the wings are wanting, and the oval elytra partially cover the abdomen. They crawl slowly on the ground and low plants [in the spring], emitting an oleaginous reddish fluid from the joints of the feet. In some parts of Spain they are used instead of, or mixed with, the common Cantharides. I have regarded them as the *Buprestes* of the Ancients, who attributed to them very pernicious properties, such as destroying oxen when eaten by them.

M. proscarabæus, Linn. [the common British species], is about an inch long, and of a black colour, shining, very punctate, the sides of the head and thorax, antennæ, and feet, tinged with violet. According to De Geer, the female deposits in the earth a great number of eggs united into a mass. The larvæ have six feet, two filaments at the extremity of the body, and attach themselves to flies, which they suck. Mr. Kirby thought this larva was an apterous insect or parasite, to which he gave the name of *Pediculus melittæ*, and at first I adopted this opinion. Dufour also formed it into a distinct genus, *Triungulinus*. But the recent researches of Lepeletier and Serville, who have reared these Triungulini from the eggs of isolated females of Meloe, do not permit us to doubt that they are the young of the Meloe. We know, indeed, that many Heteromera deposit their eggs in the nests of various Bees—may it not be the same with these Meloes, the larvæ of which attach themselves to the Bees until they have completed their provisioned nests, in which they then take up their abode?

The remaining subgenera have ordinary-sized wings and elytra.

Tetraonyx, Latr., has short maxillæ, and the penultimate tarsal joint is bilobed. [Exotic insects, chiefly Brazil.]

Cantharis, Geoff. (*Lytta*, Fabr.), has short maxillæ, entire tarsal joints, and the head is larger than the thorax. *Cantharis vesicatoria* [the common Blister-fly], is of a shiny green colour, with black antennæ. M. V. Audouin has studied its anatomy with great care, [*Ann. Sci. Nat.* vol. ix.) This insect appears in our climate [France] towards the summer solstice, and is found most abundantly on the ash and lilac, of which it consumes the leaves; it emits a most penetrating odour. Its larva lives in the earth, and feeds upon the roots of vegetables. [It has lately been found in immense numbers in England, but very locally.] In the United States of America, another species, *C. vittata*, is employed for the same purpose. It is found in abundance upon the potato.

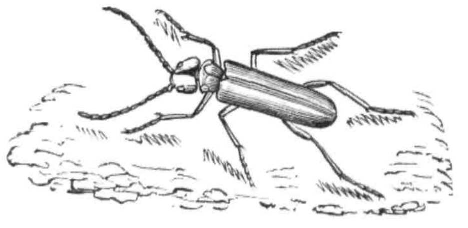

Fig. 77.—Cantharis vesicatoria.

Zonitis, Fabr., has the antennæ slenderer than in Cantharis; the maxillary palpi are filiform, and the maxillæ short.

In the two following subgenera the maxillæ are terminated by a very long silky filament.

Nemognatha, Latr., having filiform antennæ, and the thorax nearly square.

Gnathium, Kirby, with the antennæ rather thickened at the tip, and the thorax narrowed in front. [Both consisting of exotic species.]

Sitaris, Latr. (*Apalus*, Fabr.), has the elytra suddenly narrowed, so as to expose part of the wings. They reside in the larva state in the nests of Mason-bees. [*S. humeralis*, a rare British species, beautifully figured by Curtis.]

Apalus proper, Fabr., has the elytra not so strongly narrowed, and the middle joints of the antennæ rather dilated.

The third general section of the Coleoptera (TETRAMERA) exclusively comprises those species which have four [distinct] joints to all the tarsi, [a minute joint, overlooked by most authors, being affixed at the base of the terminal joint, and between the lobes of the so-called penultimate joint; hence the supposition of Latreille that the loss of the fifth joint was caused by the basal joint becoming coalescent with the second joint, cannot be maintained.]

All these insects feed upon vegetable substances. Their larvæ have generally short feet, or they are wanting and replaced by fleshy lobes in a great number. The perfect insect is found upon the flowers or leaves of plants. I divide this section into seven families; the larvæ of the first four or five live mostly hidden in the interior of vegetables, and are generally deprived of feet, or have them very minute; many of them devouring the hard and ligneous particles. These beetles are the largest of the section.

THE FIRST FAMILY OF THE COLEOPTERA TETRAMERA,—

THE WEEVILS (*Rhyncophora*),—

Is distinguished by the anterior elongation of the head, which forms a sort of muzzle or proboscis; the majority have the abdomen thick, and the antennæ elbowed and often clavate; the penultimate joint of the tarsi is nearly always bilobed, and the posterior femora are toothed in the majority.

The larvæ have the body oblong, like a very soft white worm, with a scaly head, and destitute of feet, or having only small fleshy tubercles in their stead. They devour different parts of vegetables; many live entirely in the interior of fruits or seeds, and often commit great havoc; their pupæ are inclosed in a cocoon. Many Rhyncophoræ also injure us in the perfect state, when they happen to become very numerous in certain limits. They puncture the buds or leaves of various cultivated plants, and feed upon their parenchyme.

[If Latreille, in the second edition of this work, found it necessary to state that he was compelled to omit many minute details occasioned by the works of Germar and Schonherr, the latter published in 1826, how much more necessary is it to do this now that Schonherr's great work has appeared upon the Weevils, occupying ten thick octavo volumes.]

Some have the labrum distinct; the anterior elongated part of the head short, broad, depressed, and muzzle-shaped; the palpi very distinct, filiform, or thickened at the tip. They compose the genus—

BRUCHUS, Linn.,—

Which is thus divided:—Those species with the antennæ thickened at the tips, the eyes not notched, and which have five joints in the four anterior tarsi, form the subgenus *Rhinosimus*, which we have from the latter character placed in the Heteromera.

Those with similar antennæ and eyes, but with only four joints in all the tarsi, the penultimate joint being bilobed, form that of

Anthribus, Geoff., of which the species are found in old wood, or amongst flowers.

Bruchus proper, has the antennæ filiform, often serrated or pectinated, and the eyes entire; the anus is naked, and the hind feet generally very large.

The female deposits an egg in the young and tender germ of various leguminose or cereal plants, palms, &c., upon which the larva feeds, and within which it undergoes its transformations: the perfect insect, in order to make its escape, detaches a portion of the epidermis like a small cup; hence the small holes too often observed in peas, dates, &c. The perfect insect is found upon flowers.

Bruchus Pisi, Linn., is two lines long, black, with grey spots on the elytra; it does great mischief in certain years [to peas], especially in North America. [The genus is very extensive.]

Urodon, Sch. [*Bruchela*, Meg.], differs in having the three terminal joints of the antennæ thickened.

Rhæbus, Fischer, has the elytra flexible, and the tarsal ungues bifid. *R. gebleri*, Fis. [a minute beautiful green species].

Xylophilus, Bonelli, has the palpi terminated by a mass (*Anthicus populneus, oculatus, pygmæus*). [Some of these have been separated by me into the genera *Aderus* and *Englenes* in the Zoological Journal; they appear nearer allied to *Nothus* and other Heteromera.]

The others have no visible labrum; the palpi are short, scarcely visible to the naked eye, and of a conical form; the anterior prolongation of the head forms a beak or proboscis.

Sometimes the antennæ are straight, inserted upon the proboscis, and composed of from nine to twelve joints.

Those which have the three or four terminal joints forming a mass, compose the genus—

ATTELABUS, Linn., and particularly of Fabricius.

They devour the leaves or tender parts of vegetables, the females of the majority rolling up the leaves, in which they lay their eggs, furnishing also a retreat for their young during the period whilst they are feeding.

The proportions of the proboscis, the manner in which it is terminated, the tibiæ and abdomen, have afforded characters for the establishment of four subgenera.

Apoderus, distinct by the head affixed to the thorax by a rotule.

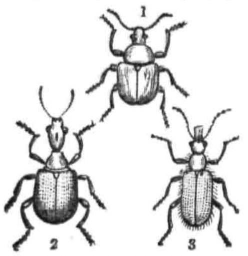

Fig. 78.—1, Attelabus curculionoides; 2. Apoderus avellanæ; 3, Rhynchites cavifrons.

Abus, has the head immersed to the eyes in the thorax.

Rhynchites, has the proboscis dilated at the tip, and the abdomen nearly square. *R. Bacchus* [a splendid but very rare British species], lives on the vine, the larvæ inhabiting the rolled-up leaves, which it devours, and thus sometimes commits great damage.

Apion, Herbst., has the body pear-shaped. See the monographs of Germar and Kirby, in *Trans. Linn. Soc.*, vol. xii. [Some of the species do much damage, devouring the seeds of clover.]

Rhinotia, Kirby [*Belus*, Sch.], has the body almost linear, and the antennæ thickened, but not clubbed.

Eurhinus, Kirby, has the antennæ terminated by a long mass, the last joint being greatly elongated in the males.

Tubicenus, Dej. (*Auletes*, Sch.), has the antennæ terminated by a perfoliated mass, and the abdomen is oblong.

Those which have the antennæ filiform, with the last joint alone forming the mass, the proboscis often longer in the males than in the females, and often differently terminated, and always stretched out in front, the body elongated, and the penultimate tarsal joint bilobed, compose the genus—

BRENTUS, Fab. (*Curculio*, Linn.)

These insects are peculiar to warm climates. Some of them, which have the body linear, and the antennæ filiform, and 11-jointed, form the subgenus

Brentus proper, Linn., which has been greatly cut up by Schonherr. From the statements of Savi and Lacordaire, it appears that these species are always found beneath the bark of trees; the only European species is the *Brentus italicus*.

Ulocerus, Schon., has the body linear, and the antennæ 11-jointed.

Cylas, Latr., has only 10-jointed, and the thorax nodose.

Sometimes the antennæ are distinctly elbowed, the basal joint being much longer than the following. These form the genus *Curculio*, Linn.

We divide them into *Brevirostres* and *Longirostres*, according as the antennæ are inserted—near the tip of the rostum, close to the mandibles,—or further back, either near the middle or at the base.

The *Brevirostres* form, according to Fabricius, two genera, [*Brachycerus* and *Curculio*].

BRACHYCERUS, Fabr.—

Has all the joints of the tarsi entire, without cushions beneath; the antennæ are short, scarcely elbowed, and only 9-jointed, the last forming the mass; they want wings; the body is very rugose, or unequal. They are peculiar to the south of Europe and Africa, living on the ground in sandy places, and appearing early in the spring. According to M. Cailliaud, the Ethiopian women suspend one of the species round their necks as an amulet.

CURCULIO,—

Has nearly all the under-side of the tarsi cushioned, and the penultimate joint bilobed. The antennæ are 11 or 12-jointed, comprising the false joint by which they are sometimes terminated. Although here much more restricted than in the Linnæan system, this genus comprises an immense number of species, particularly described by Schonherr and Germar, who have greatly divided it. They may be divided, according to our own observations, into two principal divisions.

1. Those in which the mentum, more or less orbicular, occupies all the oral cavity, and hides the maxillæ and mandibles, which are not distinctly toothed.

Cyclomus, (including Schonherr's *Cryptops*, *Deracanthus*, and *Amycterus*), has the tarsi not pulvillose, and the penultimate joint scarcely bilobed. In all the rest the tarsi are pulvillose, and the penultimate joint bilobed.

Curculio proper (including a very great number of genera of Schonherr), is winged, and has the lateral impressions of the rostrum oblique, and directed downwards; the fore legs scarcely differ from the rest. The South American species, forming the genera *Entimus*, *Chlorima*, &c., are remarkable for their splendour, and often for their size. The Diamond Beetle, (*Curculio imperialis*,) is one of them. Other small species peculiar to our climate, of a much smaller size, but scarcely less splendid, [especially under a lens,] and of a silvery or green colour, form the genus *Polydrusus*, Schonherr, *Curc. sericeus*, *micans*, *Betulæ*, &c.

Leptosomus, Sch., has the head very long behind, the rostrum very short, the thorax subcylindic, and the elytra produced into two divergent spines. A single species, *C. acuminatus*, Fabr. New Holland.

Leptocerus, (including many of Schonherr's genera), differs in having the fore-legs elongated, the tibiæ curved, the thighs thick and spined, and the tarsi often dilated and ciliated; the antennæ are long and slender. (Chiefly Brazilian species.)

Phyllobius (including also many other genera of Schonherr), is winged, but the rostral fossula is straight and short.

The Brevirostres with the penultimate joint of the tarsi bilobed, the wings wanting, as well as the scutellum form various other genera, such as *Otiorhychus*, *Omias*, *Pachyrhynchus*, *Psalidium*, *Thylacites*, *Syzygops*, *Hyphantus*, &c.

Our second general division of the genus Curculio of Fabricius differs in the narrowness of the mentum, which, from not occupying the whole breadth of the oral cavity, leaves the sides of the maxillæ and mandibles (which are toothed) exposed; the club of the antennæ is formed of five or six joints.

Those with only two teeth in the mandibles, and the labial palpi distinct, and which are destitute of wings, compose the sub-genera *Myniops*, *Rhytirrhinus* (which have simple tarsi), and *Liparus* (which has pulvillose tarsi). Those which have wings form the sub-genera *Hypera* and *Hylobius*. Those with three or four teeth in the mandibles, and the labial palpi nearly obsolete, form the subgenus *Cleonus*, including various other genera of Schonherr.

The *Longirostres*, or those with the antennæ inserted at a distance from the insertion of the mandibles, often near the middle of the rostrum, which is generally long, nearly correspond to the genera *Lixus*, *Rhynchænus*, and *Calandra*, Fabr. In the first two the antennæ are at least 10-jointed, but oftener 11-or 12-jointed; the club being at least composed of the last three joints.

LIXUS, Fabr.—

Nearly resembles Cleonus in the trophi, the long fusiform club of the antennæ, the narrow elongated form of the body, and the armature of the feet. It is nearly linear in *L. paraplecticus* [a common British species], the larvæ of which live in the stems of *Phellandrium*, and produce in horses which may happen to eat them [with the plant], the disease called "paraplégie."

Rhinocyllus, is composed of a species with the antennæ scarcely elbowed, and which, from its supposed efficacy in the toothache, [has been specifically named *R. anti-odontalgicus*].

RHYNCHÆNUS, Fabr.—

Has not such general characters. In some the sternum has not a cavity for the reception of the rostrum; and of these some have the antennæ 11- or 12-jointed, and the legs not fitted for leaping.

Thamnophilus, is winged, the antennæ short and scarcely elbowed, and the tibiæ armed with a strong hook at the tip.

Bagous, has the tibiæ curved, with a strong hook at the tip; the tarsi long and filiform. These are small insects, found in marshy places.

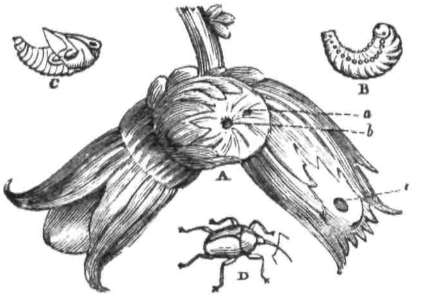

Fig. 79.—A, a branch of the filbert tree; *a*, a healed wound caused by the introduction of the egg of the nut weevil; *b*, extremity of the nut; *c*, exit hole of the grub; B, the grub of the nut weevil; C, the pupa of the same; D, the perfect insect (*Balaninus nucum*.)

Brachypus, differs from the last in having the penultimate joint of the tarsi very much dilated; the last joint sometimes without claws.

Balaninus, has the rostrum very long, sometimes longer than the whole body. *B. nucum* [the common Nut Weevil], the larva of which feeds on the kernel of the nut.

Rhynchænus, differs from the preceding by negative characters; and from the following by having 12-jointed antennæ.

Sibynia, having only 11-jointed antennæ; the club composed of seven.

Myorhinus, differs in having no wings. Many of Schonherr's genera are here united together.

We now pass to those which have only nine or ten joints in the antennæ, and are able to leap.

Cionus, Clairv., has the body nearly globular, but they do not leap. The following are able to leap, having thick hind thighs.

Orchestes, has the antennæ fixed upon the rostrum. [Many minute British species.]

Ramphus, has the antennæ fixed between the eyes.

In the remaining Rhynchæni the legs are apart at the base, and the sternum has a cavity for the reception of the rostrum.

In *Amerhinus* and *Baridius*, the latter is however wanting.

Those which possess this cavity have been distributed into a very great number of genera by Schonherr.

Camptorhynchus (*Eurhinus*, Sch.), differs in having the terminal part of the antennæ forming a thick perfoliated mass.

Centrinus, has the scutellum distinct, the club of the antennæ elongated, and the prosternum with two spines.

Zygops, has the eyes united above, and the legs very long.

Ceutorhynchus, has the scutellum scarcely visible the antennæ 12-jointed.

Hydaticus, has 11-jointed antennæ.

Orobites, has the body very short and sub-globose, the antennæ 12-jointed.

Cryptorhynchus, has the body oblong-convex; the fore-legs longest, especially in the males; antennæ 12-jointed.

Tylodes, is apterous or sub-apterous, with the scutellum wanting.

CALANDRA, Fab.—

Comprises the terminal Longirostres which have only nine joints to the antennæ, the last, or the two last, forming the club, with the tip spongy. They feed in the larva state on seeds or woody substances.

Anchonus, Sch. (with 10-jointed antennæ), and

Orthochætes, Germ. (with 9-jointed antennæ), are both apterous.

Rhina, Latr., is winged, and the antennæ are inserted near the middle of the rostrum; the fore-feet in the males are very long.

Calandra proper, has the antennæ much elbowed, but inserted at the base of the rostrum.

Calandra granaria, the Corn Weevil, commits great havoc in granaries, its larva feeding on the grain; that of *C. palmarum* feeds on the palm. Its larva is esteemed a delicacy by the natives of South America.

Cossonus, has short antennæ, inserted near the middle of the rostrum.

Dryopthorus, Sch., has only 6-jointed antennæ, and 5-jointed tarsi; none of the joints being bilobed.

THE SECOND FAMILY OF THE COLEOPTERA TETRAMERA,—

THE XYLOPHAGI,—

Have not the head produced into a muzzle; the antennæ are thickened towards the tips, or perfoliated from the base; always short, with fewer than eleven joints in the majority; the tarsi (which appear to be 5-jointed * in some), generally entire, or having the penultimate joint dilated and heart-shaped; in the latter case the antennæ are always terminated by a club, either solid and ovoid, or divided into three plates, and the palpi are short and conical. These insects generally live in wood, which their larvæ pierce, forming burrows in every direction; and when abundant in forests, especially those of firs and pines, they destroy the trees in a few years, rendering them unfit to be used in the arts. Some are also very destructive to the olive; others feed on fungi.

We divide this family into three sections.

1. Those which have the antennæ composed of ten joints at least, either terminated in a thick mass, generally solid, or having three elongated plates; or forming a cylindric and perfoliated mass from the base, and the palpi are conical; the anterior tibiæ in the majority are toothed, and armed with a strong hook; and the tarsi have the penultimate joint generally bilobed. Some have the palpi very short, and the antennæ terminated in a solid or trilamellar mass, preceded by five joints at the least. These Xylophagi compose the genus—

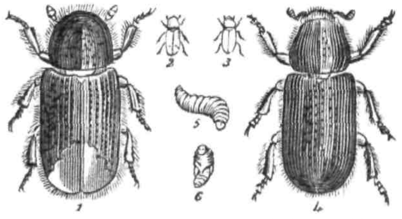

Fig. 80—1, 2, Tomicus typographus—3, 4, 5, 6, Hylurgus piniperpa (natural size and magnified)

SCOLYTUS, Geoffr.

In some the penultimate joint of the tarsi is bilobed, and the antennæ have seven or eight joints preceding the club.

Hylurgus, Latr., has the club of the antennæ solid, globular, and annulated. [*H. piniperda*, and numerous other species of minute size, some of which are very destructive to pine forests.]

Hylesinus, Fabr., has the club of the antennæ solid and annulated; but pointed at the tip.

Scolytus proper (*Eccoptogaster*, Herbst.) has the antennæ straight, naked; the club solid, very compressed, its annuli forming concentric constrictions. [*S. destructor*, and several other species, the former of which is exceedingly injurious, destroying the elms in great quantity round London.]

Camptocerus, Dej., has the male antennæ furnished below the club with long filaments.

Phloiotribus, Latr., differs from all the rest in the club of the antennæ being formed of three long filaments.

In the others the tarsal joints (apparently five in number) are entire, and the club of the antennæ commences at the sixth or seventh joint.

Tomicus, Latr., has no notches at the sides of the thorax, and the tibiæ are not striated. [Numerous minute, cylindric species.]

Platypus, Herbst., has the sides of the thorax notched to receive the femora, and the tibiæ are transversely striated.

[The insects of this genus, or rather family, have been recently described by Dr. Erichson in *Weigmanns Archiv.*, and figured in Dr. Ratzeburg's *Forst Insecten*. Several new genera are established in these works.]

The others have the palpi large, very visible, and of unequal length. The body is depressed and narrowed in front; the antennæ either 2-jointed, the second joint being very large and irregular-shaped, or 10-jointed, and entirely perfoliated; the tarsi are entire. These are exotic insects [of the most singular appearance and greatest rarity], which compose the genus

PAUSSUS, Linn.,—

[Of which I have published a monograph in the *Trans. Linn.*, and *Entomol. Society*, proposing several new genera].

* Latreille observes, that these appear to be allied to Cryptophagus, and other analogous Pentamerous Coleoptera [The fact is, that whilst some of the species here placed at the head of the Xylophagi, are extremely close in their relations to the Curculionidæ, others possess no other relation than that of being minute in size, and xylophagous in habits.]

Paussus proper, has only two joints to the antennæ, the second very large and compressed.

Hylotorus, Dalm., composed of a single species apparently with ocelli, and with the antennæ scarcely longer than the head, and 2-jointed.

Cerapterus, Swed., has the antennæ 10-jointed and perfoliated.

2. Those which have only 10-jointed antennæ, and the maxillary palpi are not narrowed to the tips, but are of equal thickness throughout, or thicker at the tips; the joints of the tarsi are always entire. They are divisible into two principal genera; those with the three terminal joints forming a perfoliated mass compose that of—

BOSTRICHUS, Geoffr.

Bostrichus proper, has the body cylindrical, the thorax forming a kind of hood over the head. The species are found in old wood and timber. [*B. capucinus*, a rare British species.]

Psoa, Fabr., has the body narrower, and thorax flat.

Cis, Latr., has the body oval, depressed, or but little elevated; the last joint of the tarsi much longer than the others; the head of the males often horned. [Many minute species, found in fungi.]

Sphindus, scarcely appears to me to differ from the last.

Nemosoma, Desmar., has the body long, linear, and the mandibles robust and exserted. [*N. elongata*, a singular small and very rare British species, found under the bark of old palings.]

The second principal genus,—

MONOTOMA,—

Has the club (or tenth joint) of the antennæ solid, and button-shaped; the body is elongated, with the front of the head narrowed into an obtuse muzzle; the palpi are very small, and, as well as the mandibles, not prominent.

Synchita, Helw., has not the front of the head prolonged, and the two basal joints of the antennæ are alike.

Cerylon, Latr., has the front of the head produced into an obtuse triangle; the first joint of the antennæ much longer than the second; the body nearly oval or parallellipiped, and the elytra not truncate behind. [*C. histeroides*, a small species found under the damp bark of trees.]

Rhyzophagus, Herbst., differs from Cerylon in its narrow elongated form and elytra truncate at the tip; the tarsi appear to me pentamerous.

Monotoma, Herbst., differs from all the preceding in having the head as large as, and separated from, the thorax, by a narrowed part. *Cerylon picipes* [and other small species, of which Aubé has given a monograph in the *Annales de Soc. Entomol. de France*].

3. Those which have eleven distinct joints to the antennæ; the palpi filiform, or thickened at the tips in some, or slender at the tips in others, the tarsal joints are entire.

In some of these the club of the antennæ consists only of two joints. These form the genus

LYCTUS.

Lyctus proper, Fab., has the mandibles and basal joints of the antennæ exposed.

Diodesma, Megerle, has the basal joint of the antennæ hidden by the side of the head: the body oval, oblong, convex. *D. subterranea.*

Bitoma, Herbst., differs in having the body long, narrow, depressed. [*B. crenata*, a small British species, found under the bark of trees.]

In the others the three or four terminal joints of the antennæ form the club, the last being larger than the preceding joints.

In some the mandibles are concealed or scarcely visible; these are the genus

MYCETOPHAGUS,—

Colydium, Fabr., has the antennæ scarcely longer than the head, and inserted beneath the advanced sides of the head, and terminated by a perfoliated mass.

Mycetophagus proper, has the antennæ at least as long as the thorax, the body oval, thorax transverse, and the club of the antennæ commencing at the sixth or seventh joint. [*M. quadripustulatus*, and several other species of small size, found under old stumps of trees, bark, &c.]

Triphyllus, Meg., has the club of the antennæ shorter, and formed suddenly by the last three joints, the last being globular.

Meryx, Latr., has the maxillary palpi exserted, and terminated by an enlarged joint, of a reversed triangular form. [*M. rugosus*, Latr., New Holland.]

Dasycerus, Brongn., has 3-jointed tarsi; the antennæ have all the intermediate joints capillary, and very setose; the abdomen is nearly globular.

Latridius, Herbst. has the palpi very short, pointed at tip; the head and thorax narrower than the abdomen, which is subquadrate, or subovate; the basal joint of the antennæ is very thick. [*L. porcatus*, and other species of minute insects, having domestic habits.]

Silvanus, has the body nearly linear, the thorax longer than broad, and as broad as the base of the elytra; the palpi nearly filiform. [*T. dentatus*, a small flat insect, often found floating in tea and coffee, introduced with the sugar.]

In others the mandibles are entirely exposed, and large; the body often narrowed and depressed. These insects compose the genus—

TROGOSITA, Olivier.

Trogosita proper, has the antennæ shorter than the thorax, the mandibles shorter than the head, and the maxillæ with a single lobe.

Trogosita mauritanica, Linn., a flat beetle, four lines long, of a pitchy black colour, found in nuts, bread, and in the bark of trees: its larva, known in Provence under the name of the *Cadelle*, attacks grain.

Prostomis, Latr. (*Megagnathus*, Meg.), has the mandibles very long, and two lobes to the maxillæ; the body is long and narrow. *Trogos mandibularis*, [a continental species].

Passandra, Dalm., has the antennæ nearly as long as the body, with the eleventh joint alone of the antennæ enlarged, in form of a reversed triangle. [Exotic species, lately monographed by Mr. Newman.]

THE THIRD FAMILY OF THE COLEOPTERA TETRAMERA,—

THE PLATYSOMA,—

Approaches the last in respect to its internal anatomy, entire tarsi, and habits; but the antennæ are of equal thickness, or slendered at the tips; the mandibles are always exposed; the palpi short, body depressed, and thorax nearly square. These insects are found under the bark of trees, and may be united into the single genus

CUCUJUS, Fabricius,—

Cucujus proper, has the antennæ shorter than the body in many species, with the basal joint shorter than the head. [*C. clavipes, depressus*, &c. See my memior on these insects in *Zoolog. Journal.*]

Dendrophagus, Gyll., has the antennæ longer, and cylindrical, with the basal joint longer than the head.

Uleoiota, Latr. (*Brontes*, Fabr.), has similar antennæ, but the third joint is as long as the following; the mandibles, in the typical species, are furnished with a long horn-like appendage.

THE FOURTH FAMILY OF THE COLEOPTERA TETRAMERA,—

THE LONGICORNES,—

Has the three basal joints of the tarsi furnished beneath with short brushes; the first and second [not the second and third, as described by Latreille], being heart-shaped, and the third [not the fourth] deeply bilobed, with a small nodule, representing a joint, at the base of the terminal joint; the labium, placed upon a short transverse mentum, is generally membranous, heart-shaped, or bifid; or horny, and in shape of a very short transverse segment of a circle, in others (*Parandra*). The antennæ are filiform or setaceous, generally at least as long as the body, either simple in both sexes, or serrated, pectinated or fan-shaped in the males; the eyes of the greater number are kidney-shaped, surrounding the base of the antennæ; the thorax is trapeziform or narrowed in front; in those which have the eyes rounded entire, or scarcely emarginate; in which case the legs are long and slender, with the tarsi elongated.

The larvæ, nearly all of which reside in the interior of trees, or under the bark, are destitute of feet, or have them only very small; the body is soft, whitish, thickest in front, with the head scaly, and furnished with robust mandibles, the other parts not being prominent. They do much injury to trees, especially those of large size, piercing them very deeply, or forming burrows in them. (See the memoir of Lansdown Guilding, in the 13th vol. of the *Linnæan Transactions*). Others devour the roots of plants; the females have the abdomen terminated by a tubular and horny oviduct. These insects produce a slight sharp sound, by the friction of the peduncle of the base of the abdomen against the inner recess of the thorax, when they alternately cause it to enter and withdraw it.

In the system of Linnæus, these insects form the genera *Cerambyx*, *Leptura*, *Necydales*, which Geoffroy, Fabricius, and other naturalists have endeavoured to arrange and simplify by the transposition of species, or by establishing other generic groups. From the immense quantity of species discovered since the days of Linnæus, and the insufficiency of the characters assigned to these genera, a complete revision of the family had become necessary, [which, since the publication of the last edition of this work, has been effected by Serville, in the *Annales de la Société Entomologique de France*, in which a series of long memoirs has been published by this author, containing numerous new genera, the number of which has been greatly augmented by Messrs. Hope and Newman, in recent memoirs published in this country].

We divide the Longicornes into two primary sections.

The first section has the eyes either deeply notched or crescent-shaped, or long and narrow; the

head is immersed as deep as these organs in the thorax, not being separated by a sudden neck; in many it is vertical.

Some of these have the terminal joint of the palpi either conical or triangular, or cylindric and truncated at the tip; the terminal lobe of the maxillæ is straight, (not inwardly curved at the tip); the head is generally porrected, or but slightly inclined; and in those few which have it vertical (*Dorcacerus*), it is nearly as broad as the body, and the antennæ are very wide apart at the base, and spinose; the thorax often very rough, and rarely cylindrical. These Longicornes compose two principal groups or tribes, [*Prionii* and *Cerambycini*].

1. The *Prionii* have, for their characters, labrum wanting or very small, and scarcely distinct; mandibles very strong and large, especially in the males; inner lobe of the maxillæ wanting, or very small; antennæ inserted near the base of the mandibles, or the notch of the eyes, but not encircled by them at the base; thorax often trapezoid or square, crenulated, or toothed at the sides.

Parandra, Latr., has the antennæ simple, nearly moniliform, compressed, not longer than the thorax, and the terminal lobe of the maxillæ small, scarcely reaching beyond the basal joint of the palpi; it is more especially distinguished by the horny tonguelet in the form of a very short transverse segment of a circle, neither notched nor lobed in front, and by the tarsi having the penultimate joint scarcely bilobed, and the last joint longer than all the rest, with two setæ at the tip of a small appendage between the claws. The body is parallellipiped, [and very shining]. The species are peculiar to America. Type, *P. lævis*, Latr.

Spondylis, Fabr., approaches Parandra in the form of its antennæ and maxillary lobes, but it has the tonguelet as in all the rest of the Longicornes, membranous, heart-shaped; the penultimate joint of the tarsi is deeply bilobed, and it is destitute of the setigerous appendage between the claws. *S. buprestoides*, Linn., 6 or 7 lines long. [Inhabits the North of Europe.]

Prionus.—The third and last genus of this tribe has the antennæ longer than the head and thorax, serrated or pectinated in some, simple and slender at the tips, and with elongated joints in others; the terminal lobe of the maxillæ is at least as long as the two basal joints of the palpi; the body is generally depressed, with the thorax square or trapezoid, and either toothed, spined, or angular at the sides.

These insects only fly in the evening or during the night, and always settle upon trees. Some exotic species are remarkable for their size, and the enormous developement of their mandibles. The larvæ of *Prionus cervicornis*, which lives in the wood of the Gossampinus tree, is eaten [by the natives of South America].

This genus comprises a very great number of species, which, from the variety in the form and size of their mandibles, antennæ, thorax, and abdomen, are divisible into many smaller subgenera, described by M. Serville, [in the memoir above alluded to]. Some of the species have the body elongated, straight, with the thorax much shorter than the abdomen, and greatly curved at the sides, and the mandibles of large size in the males. Amongst these are the continental species, *P. scabricornis*, and many large exotic species.

Others have the body not so oblong, somewhat depressed in front, and with moderate-sized mandibles in both sexes, and the antennæ strongly serrated in the males. Amongst these is

Prionus coriarius [the only British species], an inch and a half long, and of a brown black colour. It lives in the larva state in the rotten trunks of oaks, &c.: when ready to undergo its transformation, it forms a hole in the earth.

Anacolus, Lep. and Serv., has the elytra small and triangular. [Brazilian insects.]

Other species, of varied and often metallic colours, have the body shorter and broader, nearly oval, the antennæ simple, the head prolonged behind the eyes, &c.

The *Cerambycini* have the labrum very distinct, and extending across the entire front of the head; the two maxillary lobes are very distinct and exserted; the mandibles of the ordinary size, and alike or scarcely differing in the two sexes; the eyes always notched; the antennæ ordinarily as long as, or longer than the body; the thighs, or at least the four anterior, are generally clavate, being slender at the base.

We arrange in the first place those which have the last joint of the palpi evidently thicker than the preceding, of a triangular or conical form; the head not being materially narrowed, and prolonged in front like a muzzle, the thorax not dilated from the front to the hind part, and the elytra not in the shape of small scales, nor suddenly narrowed from the base and terminated like an awl. These constitute the normal group of the Cerambycini, the others being in several respects anomalous, the last of which appear to connect this tribe with the following. They compose the genera *Cerambyx*, *Clytus*, *Callidium*, and part of *Stenocorus*, Fabr. They are the *Cerambyx* of Linnæus, to which some of his Lepturæ are to be united. Modern Entomologists [especially Serville,] have greatly augmented the number of their generic groups, but their characters are so slight that they may be reduced to one,—

CERAMBYX.

A great number of species, all from South America, proportionably shorter and broader than the following, with the antennæ often pectinated serrated, or spined, are remarkable for the extent of the thorax, of which the length

nearly equals half of that of the elytra, sometimes smooth, semiorbicular with a single tooth at the posterior angles, sometimes very unequal and tubercular; the prosternum is either carinated or terminated in a point, either flat, truncated, entire, or notched at its posterior extremity, which is applied to a produced lobe of the mesosternum; the fore-legs at least are wide apart at the base. The scutellum is large in some, the tarsi short and dilated.

Lissonotus, Dalm. (with the antennæ greatly compressed and serrated, or semi-pectinated and long), and

Megaderus, Dej. (with simple antennæ, shorter than the body), form a first division, having the thorax nearly semi-orbicular and very large, with a single tooth on each side at the hind angles, and the scutellum very large.

Those with the thorax very rough and multidentate, the antennæ long, simple, or slightly spined, and the thorax very large, form four subgenera.

Dorcacerus, Dej., having the head vertical, large, and nearly as broad as the thorax, and the scutellum small. Type, *Cerambyx barbatus*, Oliv.

Trachyderes, Dalm., with the thorax large and much broader than the head; the posterior extremity of the prosternum, and also the opposite part of the mesosternum, elevated and keeled.

Lophonocerus, Latr., has the head much narrower than the thorax, and with the third and three following joints of the antennæ furnished with hairs. *Cerambyx barbicornis*, Oliv., &c.

Ctenodes, Klug, differs from the preceding in having the antennæ much shorter than the body, and pectinated or serrated; the thorax toothed at the sides. (*Ctenodes zonata*, &c.)

In the following the thorax, either square or cylindrical, orbicular, or nearly globular, is much shorter than the elytra; the prosternum is neither carinated nor pointed at its posterior extremity, and the scutellum is always small.

Phœnicocerus, Latr., differs from all the rest in having the third and following joints of the male antennæ prolonged into flattened plates, forming a large fan. *P. Dejeanii*; Brazil. In the rest the antennæ are only simple or serrated.

Callichroma, Latr., comprises many species, remarkable for their colours, and the agreeable odour they emit, and these exhibit a curious anomaly in the maxillary palpi being very much smaller than the labial, and even than the maxillary lobe, which is advanced; the posterior tibiæ are often compressed. [The only British species,] *Cerambyx moschatus*, Linn. [or the Musk Beetle as it has been erroneously named, the scent it emits being more like otto of roses than musk], is about an inch long, entirely green, or shaded with blue, some specimens being of a more golden colour. [This handsome species is very common upon willows, and may be easily detected by its scent.] There are numerous other species found on the Continent and in America.

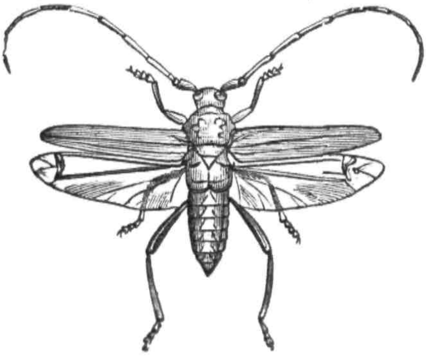

Fig. 81.—Callichroma moschata

Other Longicornes of the same division, but with ordinary-shaped maxillary palpi, are distinguished from the following by possessing twelve distinct joints in the antennæ, at least in the males; we unite them into the single subgenus—

Acanthopterus, Latr.—Some American species, with the thorax nearly square or subcylindrical, and the elytra ordinarily terminated by one or two spines, are called *Stenocorus*, by Dalman; others, peculiar to the western parts of the Old World, with the thorax nearly globular, and the antennæ simple and not fasciculated, form the subgenus *Purpuricenus*. Types, *Cerambyx Kœhleri*, *Desfontainii*, &c. Another species,

Cerambyx alpinus, Linn., has the body depressed, and the third and three following joints of the antennæ terminated by a little bundle of hairs.

The following Cerambycini have only eleven joints to the antennæ; some, or at least the males, have the antennæ long and setaceous; the last joint of the palpi in the form of a reversed cone; the thorax is either nearly square and a little dilated in the middle, or oblong and nearly cylindrical; it is often rugose, and tubercled at the sides. These compose the subgenus

Cerambyx proper, some of which have been further separated under the name of *Hamaticherus*, having the thorax very rough, and spined or tubercled at the sides in the middle, with the third, fourth, and fifth joints of the antennæ evidently thicker than the following, thickened, and rounded at the tip. *C. heros*, Fab., is an abundant continental species, the larva of which forms deep burrows in oak wood, and which is probably the *Cossus* of the ancients.

We unite in the same subgenus different species of Callichroma of Dejean, having the thorax entire or scarcely unequal, and either oval or subcylindrical. These are exotic, and nearly all from America, being of small size.

We further unite in the same genus the *Gnomæ* of Dejean, having the thorax very long and cylindrical.

The Cerambycini with the antennæ generally scarcely longer than the body, the thorax always unarmed, and sometimes nearly globular or orbicular, and sometimes narrower and subcylindrical, the palpi always very short, terminated by a thicker joint than in the preceding, form the genus *Callidium*, which now constitutes three :—

Certallum, Dej., has the head at least as broad as the thorax, which is cylindrical, or slightly dilated in the middle. Type, *C. ruficolle*, Fabr. [a French species].

Clytus, Fab., has the head narrower than the thorax, nearly globular. *Clytus arcuatus*, [a rare British species, and others].

Callidium, has the thorax in like manner broader than the head, flattened, and orbicular. [*Callid. Bajulum*, a very common insect, very destructive to wooden posts and rails.]

We terminate this tribe by insects which, in respect to the palpi, the form of the head, thorax, and elytra, as well as their respective proportions, offer various exceptions or anomalies, commencing with those in which the thorax has a form analogous to that of Certallum. It is of the breadth of the head and of that of the base of the elytra, or scarcely narrower, and either subcylindrical, round, or orbicular, and is broader towards the middle. All the thighs are clavate, and placed upon a suddenly formed slender and elongated pedicle. The elytra in the majority are either very short, or suddenly narrowed at a short distance from the base, and then subulated. Those of the first groups however do not exhibit such diversity in the elytra.

Obrium, Meg., has the head rounded, and not prolonged in front into a muzzle; the palpi with the last joint thickened, and truncate at the tip; antennæ shorter than the body, and thorax long and narrow.

Rhinotragus, Germ., has the head produced into a muzzle; the thorax suborbicular. They evidently approach the next subgenus.

Necydalis, Linn., are the only species which have the elytra contracted into a pair of very short scales, or extended to the tip of the abdomen, but narrowed suddenly at a little distance from the base, thus (alone) resembling Œdemera; the abdomen is long and narrow, and apparently pedunculated at the base. The species with subulated elytra compose the subgenus *Stenopterus*, (*S. rufa*, Linn.) [a reputed British species.] Those with very short, scalelike elytra form the subgenus *Necydalis* proper, or *Molorchus*, Fab. Type, *N. major*, Linn. [a rare British species, figured by Curtis].

Certain species, for the most part peculiar to the African islands, New Holland, New Ireland, and New Zealand, anomalous in several respects, and which in a natural order ought probably to be placed between the Lamiariæ and Lepturetæ, will terminate the division of the Cerambycini. These have the palpi nearly filiform, with the last joint subcylindrical, slightly narrowed towards the base; the thorax mostly smooth, or slightly unequal, without acute tubercles, dilated from the front to the hind part, trapeziform or truncate conical, as in the last tribe of this family; the abdomen is nearly in form of a reversed triangle in many, and the elytra are truncate.

Distichocera, Kirby, has the male antennæ dilated to the tip, and with furcate joints. [New Holland.]

Tmesisternus, Latr., has simple setaceous antennæ, longer than the body; the thorax is lobed behind, prosternum prolonged behind, truncate, and received into a notch of the mesothorax. (Undescribed species, from New Ireland.)

Tragocerus, Dej., has not the prosternum produced; the antennæ filiform, and rather shorter than the body, subserrated; thorax unequal, and elytra oblong.

Leptocerus, which have not the prosternum produced behind; antennæ setaceous, much longer than the body, especially in the males, and the elytra subtriangular. *Cer. scriptus*, Linn. Isle of France.

The Longicornes of our third tribe, the *Lamiariæ*, are distinguished by having a vertical head; the palpi filiform or scarcely thickened at the tips, and terminated by a more or less ovoid joint, pointed at the tip. The outer lobe of the maxillæ is slightly narrowed at the tip, and bent over the inner division. The antennæ are often setaceous and simple, and the thorax, exclusive of its tubercles or spines, is nearly of equal breadth throughout. Some of the species are apterous, a peculiarity which occurs in no other division of this family.

This tribe is composed of the genera *Lamia* and *Saperda* of Fabricius, and some of his *Stenocori*.

Cerambyx longimanus, Linn., neither belongs to this genus nor to Prionus, where it was at first placed, but to a distinct one belonging to the Lamiariæ, namely,

Acrocinus, Illig. (*Macropus*, Thunb.), distinguished from all other Longicornes by having the thorax furnished on each side with a moveable tubercle, terminated by a point or by a spine. The body is flattened, the thorax transverse, antennæ long and slender, the fore-legs longer than the others, and the elytra truncated at the tips and terminated by two spines, the outer one being the longest; the most remarkable species is the *A. longimanus*, in which the thighs and tibiæ of the fore-legs are very long and slender; the upper side of the body is agreeably diversified with grey, red, and black colours.

All the other Lamiariæ compose but a single genus,—

LAMIA,—

Which we divide into two sections,—those with the sides of the thorax tubercular or spined, and those in which it is entire and cylindric. The first is again divided into those with and those without wings. A great number of

the former, from South America, having the body shorter, broader, and depressed, with the thorax transverse, the abdomen nearly square, scarcely longer than broad, the feet robust, and the tarsi much dilated, form the genus—

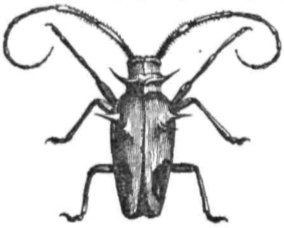
Fig. 82.—Acanthocinus speculifer.

Acanthocinus, Megerle, of which we possess only three European species. One (*L. ædilis*, Fabr.) is remarkable for the male antennæ being more than four times the length of the body.

Others of a similar form, with the antennæ bearded or fasciculated, form the subgenus *Pogonocherus*, of which there are several British species, nearly all of which are remarkable for having the elytra obliquely truncate at the tips.

Tetraopes, is but slightly elongate, and has each eye entirely divided into two parts by the tubercle, from whence arises the antennæ.

Monochamus, Dej., has the body narrow and long, the antennæ exceedingly long, a strong spine on each side of the thorax, middle tibiæ slightly bent.

In Dejean's catalogue, if we except the apterous species, the other *Lamiæ* of Fabricius are retained under the generic name *Lamia*, but Dahl has separated *C. curculionoides* and *nebulosa*, (French species), under the name of *Mesosa*, which is nearer to Saperda, in having the thorax not spined at the sides.

Lamia textor, [a very rare British species], an inch long, and of a dull black colour, conducts to—

Dorcadion, Dalm., composed of the species which have no wings, a group peculiar to Europe and the adjacent parts of Asia, and of which the larva probably feeds upon the roots of vegetables.

Parmena, Megerle, has been separated from the last from having the antennæ longer than the body.

The other Lamiariæ have the thorax not armed at the sides with tubercles or spines, but cylindrical, the body always elongated, and nearly linear in many species. These compose the genus—

SAPERDA, Fabricius.

Gnoma, Fabr., restricted to some species from Java, New Holland, Sumatra, &c., resemble Lamia in the position of the head and the parts of the mouth, but the thorax is as long as the abdomen, cylindrical, and more slender in the middle; the fore-legs are very long. *C. longicollis*, *Giraffa*, &c.

Adesmus, Dej., has the first and third joints of the antennæ greatly elongated, exceeding more than one third of the whole antennæ.

Apomecyna, Dej., has the body cylindric, antennæ filiform, short, terminated in an acute point; the third and fourth joints very long, and the following very short. [Species proper to the East Indies and Isle of France.]

Colobothea, Dej., has the antennæ close together at the base, the body compressed, the elytra notched or truncate at the tips, with the outer angle produced into a spine. This group is peculiar to South America, and to the most eastern of the Islands of the Asiatic Archipelago.

Other Saperdæ, from Brazil, with the thorax as broad as or scarcely narrower than the elytra, have the third and fourth joints of the antennæ very elongated and dilated, and the elytra dilated behind. (*Saperda amicta*, *togata*, &c.) Many other Saperdæ with the body very long and narrow have the antennæ 12-jointed, thus forming a distinct group. (*Saperda Cardui*, &c.)

Amongst the species considered by all Entomologists as true Saperdæ, may be mentioned *Saperda carcharias*, Linn. [a British species lately discovered in the fens of Huntingdonshire and Cambridgeshire, in great quantities, and which is figured in the *Entomologist's Text Book*], the larva of which lives in the trunks of poplars, and sometimes destroys young plantations.

Some species have the body still more narrow, and the antennæ excessively long.

The fourth and last tribe, that of the *Lepturetæ*, is distinguished by having the eyes rounded, entire, or scarcely emarginate; the antennæ inserted more in front, or at the anterior extremity of the slight emargination of the eyes; the head is posteriorly prolonged behind the eyes in many, or suddenly narrowed into a neck at its junction with the thorax, the latter being conical and narrowed in front. The elytra gradually diminish in width to the tip.

This tribe composes the genus

LEPTURA, Linnæus,—

Except such species as belong to the preceding tribes and to the Donaciæ. Thus modified, the genus corresponds to *Stenocorus*, Geoffr., and to those of *Rhagium* and *Leptura* of Fabricius. In some species the head is elongated immediately behind the eyes; the antennæ often shorter than the body, and close together at the base, inserted at a distance from the eyes upon two small eminences like tubercles, and separated by an impressed line; the thorax is ordinarily tubercular, and spined at the sides.

Desmocerus, Dej., has the palpi filiform, with the last joint of the maxillary nearly cylindrical; the third and two following joints of the antennæ are dilated at the external angle, especially in the males. *D. cyaneus*, Fab.; North America.

The following differ in having the palpi dilated at the extremity, and terminated by a conical joint; the antennæ regular.

Vesperus, Dej [consisting of a few species from the south of Europe], differs in the males alone being winged; the thorax is conical, entire, and without spines or tubercles; the elytra of the females [which sex is very broad and convex], are short, and gaping at the tip.

Rhagium, Dahl. [and the three following, having wings in both sexes], has the antennæ simple, not more than half the length of the body, and the last joint of the palpi forms a triangular mass. The head is large, nearly square, with the eyes entire; the sides of the thorax have a triangular tubercle. [*R. bifasciatum*, and two or three other British species.]

Rhamnusium, Meg., has the antennæ rather shorter than the body, serrated, with the third and fourth joints shorter than the following; the eyes are evidently emarginate. *R. Salicis*, Fab., [an European species].

Toxotus (and *Pachyta*, Dej.), has the antennæ at least as long as the body, simple, with the basal joint much shorter than the head; the eyes are entire, or very slightly emarginate.

Euriptera, Serv. & Lep., has the antennæ 12-jointed. [A Brazilian insect.]

Distenia and *Cometes*, Serv. & Lep., have the thorax spined at the side, palpi short, antennæ villose. The former has the elytra narrowed and terminated by a spine, in the latter they are linear and unarmed. Both are Brazilian.

Stenoderus, Dej., has the antennæ long, the basal joint at least as long as the head, and the body long, narrow, and linear; the eyes are entire. [Exotic insects].

In the other species the head is suddenly narrowed immediately behind the eyes; the antennæ, inserted near the anterior extremity of their internal notch, are wide apart at the base; the two prominences from which they spring are nearly on the same plane; the thorax is mostly entire at the sides. These form the genus—

Leptura proper, some of which have the thorax conical, as in *Lept. armata*, Gyll. (*L. calcarata*, Fab.), [a very common British species, of a black colour, with yellow marks in the elytra], whilst in others the thorax is nearly globular, as in *L. tomentosa*, [another common British species, of smaller size and black colour].

THE FIFTH FAMILY OF THE COLEOPTERA TETRAMERA,—

THE EUPODA,—

Is composed of insects, the first of which (the *Donaciæ*) so closely approach the last of the Longicornes, that Linnæus and Geoffroy united them together, and the last of which are so close to the Chrysomelæ, the types of the following family, that the first of these naturalists placed them in this genus. The parts of the mouth exhibit the same relations: thus, in the first, the tonguelet is membranous, bifid, or bilobed, as in the Longicornes; the maxillæ also greatly resemble theirs; but in the terminal Eupodæ the tonguelet is nearly square or rounded, like that of the Cyclica. The lobes of the maxillæ are however membranous, or but slightly coriaceous, whitish, or yellowish; the exterior is dilated at the tip, and has not the appearance of a palpus, which thus more nearly resembles that of the Longicornes than of the Cyclica. The body is more or less oblong, with the head and thorax narrower than the abdomen; the antennæ are filiform, or thickened at the tips, and are inserted in front of the eyes, which in some are entire, round, and prominent, and in others slightly notched; the hind part of the head enters into the thoracic cavity; the thorax is cylindrical or transversely square; the abdomen is larger compared to the other parts of the body, oblong, or in the form of a long triangle; the joints of the tarsi, except the last joint, are cushioned beneath, and the penultimate joint is bifid or bilobed; the hind legs are thickened in a great number, whence the origin of the family name. All these insects have wings, and fix themselves to the stems or leaves of plants, more especially to the Liliaceæ in respect to many of our native species; the larvæ of some (*Donaciæ*), devour the interior of the stems of water plants, upon which the perfect insect is found; those of others feed externally, but covered with their own excrements, which forms a kind of mantle, as in the Cassidæ.

We divide this family into two tribes, [*Sagrides* and *Criocerides*].

The first, *Sagrides*, is composed of the genus—

SAGRA,—

The mandibles of which terminate in an acute point. The tonguelet is deeply bilobed. Some have the palpi filiform, the eyes emarginate, and the hind thighs very thick, with the tibiæ curved.

Megalopus, has the front of the head produced into a muzzle; the mandibles strong and crossing each other; the antennæ are thickened at the tips. Handsome Brazilian beetles. See the monographs of Klug, Mannerheim, [and Gistl].

Sagra, Fabr. [first named *Alurnus*], is exclusively confined to South Africa, Ceylon, [Java], and China, and has the palpi terminated by an ovoid joint, the antennæ nearly filiform, and the four anterior tibiæ straight; they are splendidly coloured, being golden, green, or copper-coloured.

The others have the palpi thickened at the tips, the eyes entire, and the thighs of nearly equal thickness; the body is narrow and depressed.

Orsodachna, Latr., has the antennæ filiform, composed of reversed-conical joints; the last joint of the palpi alone is rather larger than the preceding, and nearly of an ovoid truncate shape. [Several small British species.]

Psammoecus, Boudier [*Crypta*, Kirby], has the antennæ composed of short joints, thickening to the tips, and

the maxillary palpi suddenly terminated in a large triangular joint. *Anthicus 2-punctatus*, Fab., placed in this situation by Latreille, with doubt [and inserted by English Entomologists near Latridius and other pesudo-Xylophaga.] [The genera *Carpophagus* and *Megamerus*, Macleay, are composed of New Holland insects, allied to Sagra.]

The second tribe, *Criocerides*, is distinguished from the preceding by the mandibles having the tip truncated, or with two or three teeth, and by the tonguelet, which is either entire or but slightly notched. It is composed of the genus

CRIOCERIS, Geoffr.—

which we divide as follows :—

Sometimes the mandibles are pointed, and with two or three teeth at the tips. The palpi are filiform. The antennæ, of the ordinary thickness, are nearly moniliform in some, and composed of reversed conical joints in others, with the tips evidently thickened.

Donacia, Fab. (*Leptura*, Linn.), has the posterior thighs large and thickened; the antennæ of equal thickness throughout; the eyes entire, and the last joint of the tarsi almost entirely received between the lobes of the third joint. These insects are often brilliantly coloured, and bronzed or gilt. Many also exhibit a silky coating, which must be useful to them when they fall into the water. They ordinarily live upon aquatic plants, as the Sagittaria, Nymphæa, &c., upon which they take firm hold. It is in their roots that their larvæ reside. Their pupæ, according to M. A. Brongniart, are attached to their filaments by only one side, and thus form knots or bulbs. The larvæ are naked and hidden, like those of the Lepturidæ. [The genus comprises a great number of British species.]

Hæmonia, Meg. [*Macroplæa* of the British Catalogues], are Donaciæ with the penultimate joint of the tarsi very small and nearly entire, and the last very long. [*D. Equiseti* and *Zosteræ*, [rare British species].

Petauristes, Latr., has the hind thighs large, but the eyes are notched; the antennæ composed of shorter joints, and the lobes of the third tarsal joint only receiving the base of the last joint. [*Lema varia*, Fabr.]

Crioceris proper (*Lema*, Fabr.), differs from the preceding in having the hind thighs scarcely different from the others. The antennæ are slightly thickened at the tips, and are nearly moniliform, the joints being scarcely longer than thick; the eyes are prominent and notched; the hind part of the head forms a kind of neck.

These insects live upon Liliaceæ, Asparagus, &c., and, like those of the preceding family, make a slight noise when seized. Their larvæ feed upon the same plants, on which they take firm hold by means of their six scaly feet. They have the body soft, short, and swollen; their excrements are occasionally used by them to form a covering over the back, defending them from the action of the sun; the anus is for this purpose placed upon the back. They descend into the earth to become pupæ.

Crioceris merdigera, the Lily Beetle, is three lines long, with the thorax and elytra red. It is found throughout Europe upon the White Lily. M. Boudier has published some observations upon the French species, *L. brunnea*, in the *Memoirs of the Linnæan Society of Paris.*

Crioceris Asparagi, [the Asparagus Beetle, is of a smaller size], being blue, with the thorax red with a spot in the middle, and the elytra are yellowish white with blue markings. [Its larva feeds upon the young sprigs of asparagus, and sometimes does damage to the plants. See my memoir on this insect in the *Gardener's Magazine.*] *Cr. 12-punctata*, Linn., also feeds on this plant.

Fig. 83.—Crioceris Asparagi.

Auchenia, Thunb. [*Crevia*, Kirby], differs in having the eyes entire; the palpi pointed at the tip; the seven terminal joints of the antennæ thickened, and the thorax with the sides dilated in the middle—(*Crioceris subspinosa*, Fab.)

Megascelis, Dej., differs from the preceding in having the mandibles truncate; the palpi terminated by a swollen truncate joint, with a small joint-like prolongation. The species are of small size, and peculiar to South America.

THE SIXTH FAMILY OF THE COLEOPTERA TETRAMERA,—

THE CYCLICA,—

Has also the under-side of the three basal joints of the tarsi spongy or pulvillose, the third being bilobed, and the antennæ filiform, or slightly thickened at the tips; the body is also generally rounded, with the base of the thorax as broad as the elytra in the species, few in number, in which the body is oblong; the maxillæ have the outer lobe of a narrow form, nearly cylindrical and palpiform, and the inner lobe is broader, and without a scaly hook. The tonguelet is nearly square, or oval; entire, or slightly emarginate. All the larvæ with which we are acquainted are furnished with six feet; the body is soft, coloured; they feed like the perfect insect upon the leaves of different vegetables, where they ordinarily affix themselves by a glutinous secretion; it is there also where many of them become pupæ, the exuviæ of the larvæ being crumpled up at the extremity of the body of the pupæ, which are often varied in their colours. Other larvæ enter the earth.

These insects are generally of small size, often ornamented with metallic and brilliant colours, with the body naked and without hairs. They are generally slow in their motions, timid, and fall to the

earth when attempted to be seized, folding the antennæ and legs beneath the body. Many species leap well. The females are very prolific.

In respect to the different habits of the larvæ, the Cyclica are divided into four principal groups:—1. Larvæ which cover themselves with their own excrement; 2. Larvæ living in tubes, which they bear about with them; 3. Naked larvæ; and, 4. Larvæ which live in the interior of leaves, feeding on their parenchyme—(*Cyclica saltatoria.*)

Such are the principles which have influenced us in our arrangement of this family. We divide them into three tribes, from the mode of insertion of the antennæ, [*Cassidariæ*, *Chrysomelinæ*, and *Galerucitæ*].

The *Cassidariæ*, [or Tortoise Beetles,] which form the first tribe, have the antennæ inserted at the upper part of the head, close together, straight, short, filiform, and nearly cylindrical, or gradually thickened towards the tip; the mouth, entirely placed beneath, with short, nearly filiform palpi, is sometimes arched round and sometimes partially received in a cavity of the prosternum; the eyes are ovoid and round; the feet contractile, short, with the tarsi flattened, the lobes of the third joint entirely receiving the terminal joint. The body being flat beneath, these insects, by means of the arrangement of the tarsi, lie close upon the leaves, where they generally remain immoveable. In other respects the body is generally orbicular or oval, and margined all round by the dilated thorax and elytra. The head is hidden beneath the thorax, or received in an anterior notch. Their colours are very varied, and prettily arranged in spots, points, rays, &c. Such of their larvæ as we are acquainted with cover themselves with their own excrements. The Cassidariæ form two genera. The first, or that of

HISPA, Linn.,—

Has the body oblong, with the head entire, exposed, and free, and the thorax trapeziform. The mandibles have only two or three teeth; the outer lobe of the maxillæ is shorter than the inner; the antennæ are filiform.

Alurnus, Fabr., has the extremity of the mandibles prolonged into a strong tooth, with a shorter tooth on the inside; the tonguelet is horny. These are South American insects of large size.

Hispa, Linn., has the mandibles terminated by two or three small teeth of nearly equal size. There are a great number of American species. Many have the upper surface of the body, as well as a portion of the antennæ, armed with many spines. Such is *Hispa atra*, Linn., a small black species [of very rare occurrence in England], which is found upon grass.

Chalepus, Thunb., has the tibiæ longer, slender, and curved, and the two anterior armed with a long spine in the male (*H. spinipes*, Fabr.). Some species of Hispa have a frontal horn. *H. rostratus*, Kirby, forming another subgenus.

CASSIDA, Linn.—

Is distinguished from Hispa by having the body orbicular, or subovoid, or nearly square in a few species. The thorax, more or less semicircular, entirely hides or covers the head, or receives it in a deep frontal notch; the elytra, often elevated in the scutellar region, form a broad margin to the body; the mandibles offer at least four teeth, and the outer maxillary lobe is at least as long as the internal lobe.

Imatidium, Fabr., differs only in having the head exposed, and received in a notch of the thorax. The body in all the Cassidæ is depressed, nearly round, shield or tortoise-shaped, often elevated pyramidically in the middle of the back, and margined all round by the sides of the thorax and elytra. The under-side of the body is flat, so that these insects fix themselves quite close to the plants on which they are stationed.

Cassida viridis, is about 1-6th of an inch long; is of a green colour, with black thighs. Its larva lives on thistles and artichokes. Its body is very flat, and furnished with spines all round the edges, and entirely covered by its own excrement, which it attaches in a mass together, and carries on a kind of fork fixed near the anus. The pupa is also very flat, with thin toothed appendages at the sides of the body; the thorax is broad, rounded in front, and covers the head. In the larva of a species from St. Domingo the excrements form small numerous articulated filaments like a wig.

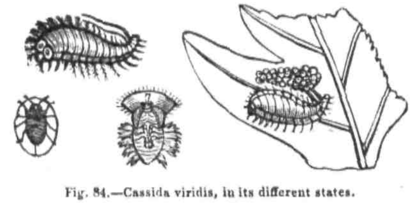
Fig. 84.—Cassida viridis, in its different states.

[The genus is very numerous, and comprises many singular forms, some of which have been recently separated as subgenera by the Rev. F. W. Hope, in the *Annals of Natural History.*]

The second tribe (*Chrysomelinæ*) has the antennæ inserted in front of the eyes, or near their inner extremity, and wide apart. These insects do not leap; they form, with the following tribe and some of the preceding family, the genus *Chrysomela* of Linnæus; but which, from its actual extent, we have restricted by the adoption of some other. The species which possess the above characters form, as in the early works of Fabricius, two genera.

The first of these genera,—

CRYPTOCEPHALUS,—

Is composed of Chrysomelinæ in which the head is inserted vertically into a swollen thorax like a hood, so that the body, generally in the form of a short cylinder, or nearly ovoid, and narrowed in front, appears from above to be truncated and deprived of a head. The antennæ in some are more or less serrated or pectinated; in others they are long and filiform. The last joint of the palpi is always ovoid.

In some the antennæ are short, pectinated, or serrated after the fourth or fifth joint.

Clythra, Fabr., has the outer margin of the elytra straight, or with but a slight notch; the posterior angles of the thorax are rounded and not arched, and the anterior are not inflexed beneath. The body is always in form of a short cylinder; the antennæ are always free; the eyes entire, or scarcely emarginate. The males have the head generally large, with the mandibles large and porrected, and the fore-legs long. *C. quadripunctata*, Linn., [a common British species]. Its larva lives in a coriaceous kind of tube, which it bears about with it.

The following differ in having the elytra much dilated externally at the base, with a deep notch. The posterior angles of the thorax are acute and arched, and the anterior are greatly inflexed. The eyes are often notched. These are peculiar to the New World.

Chlamys, Knoch., has the body short, cylindric, or cubic, and the surface of the body is very unequal. [See the monographs of Klug and Kollar.]

Lamprosoma, Kirby, has the body globular [and very smooth].

In others the antennæ are evidently longer than the head and thorax, simple, filiform, or thickened to the tips.

Cryptocephalus, Geoffr., has the body cylindric; the thorax as broad as the abdomen, and the antennæ and palpi of equal thickness throughout. *C. sericea*, Linn. [a common British species. The genus is extremely numerous].

Choragus, Kirby, has the antennæ terminated by three large joints. *C. Sheppardi*, [a small British species. This genus is more allied to *Anthribus* and *Bruchus*.]

Euryope, Dalm. (having the mandibles very strong, and the second joint of the antennæ longer than the third), and

Eumolpus, Klug (with the mandibles of ordinary size, and the second joint of the antennæ shorter than the third), differ in having the body narrowed in front and nearly ovoid.

Eumolpus Vitis, a small continental species, does much injury to the vine. This genus passes, by means of *Colaspis*, in a very gradual manner, to the genus

CHRYSOMELA,—

In which the body is generally ovoid or oval; the head exposed, advanced, or slightly inclining forwards; the antennæ simple, about half the length of the body, and often moniliform and slightly thickened to the tips.

Some, having the body ovoid, or oval, and winged, and the palpi pointed at the tips, approach Eumolpus, and are distinguished from all the following by the filiform antennæ, longer than half the body.

Colaspis, Fabr., has not the mesosternum pointed. [A very numerous exotic genus.]

Podontia, Dalm., has the mesosternum produced into a short conical point. [Exotic insects.]

In the following Chrysomelinæ of the same tribe the antennæ are shorter, and composed of reversed-conical joints, or more or less moniliform, and thickened to the tips; the false joint, or appendage, at the end of the last, is very short, and scarcely distinct.

Some have the maxillary palpi thick, and truncated at the tip.

Amongst these some have the two terminal joints of the palpi united into a truncated mass, the last shorter than the preceding, and either transverse or in the form of a short truncated cone.

Phyllocharis, Dalm., has the mesosternum not pointed. [Exotic species], peculiar to New Holland and Java.

Doryphora, Illig., has the mesosternum pointed like a horn. Composed of South American species.

Cyrtonus, Dalm., composed of two Spanish species, has no mesosternal point, but the joints of the antennæ are longer, the body more globose, and the thorax more elevated transversely.

Apamæa, Leach, is allied to Doryphora, but has the antennæ of the male 8-jointed, the last two forming a club.

[*Trochalonota*, Westw., is also globose. Type, *Chrysomela badia*, Germ. South America.]

Paropsis, Oliv. (*Notoclea*, Marsh.), is peculiar to New Holland, and is distinct by having the last joint of the maxillary palpi hatchet-shaped. [See the monograph on this genus, published by Marsham in the *Transactions of the Linnæan Society of London*.]

In the two following subgenera the same joint, quite distinct from the preceding, and as large or larger than it, is more or less semi-ovoid. These insects are widely distributed over the Old World, and particularly Europe.

Timarcha, Meg., is composed of apterous species, having the body gibbose; the antennæ moniliform, especially towards the base; the elytra united together, and the tarsi very dilated, especially in the males. These insects are found on the ground in woods, upon turf, and low herbs at the sides of foot-paths, crawling slowly, and emitting a yellow fluid from the joints of their feet when disturbed. They especially inhabit the south of Europe, and the northern countries of Africa. Amongst those which have the thorax narrowed behind, and nearly of a crescent-shape, and which are the largest of the tribe, is the (*Tenebrio*) *lævigatus*, Linn. [a common British species], from four to eight lines long; black, with the thorax and elytra smooth, finely punctured, and the antennæ and feet violet-coloured. Its larva is green or violet-coloured, very swollen, with the extremity yellow. It is found on the Lady's bed-straw. It undergoes its transformations in the earth.

Chrysomela proper, comprises those species of Olivier which are furnished with wings, and in which the maxillary palpi, according to the subdivisions established above, have the last joint as large as or larger than the preceding, of an ovoid-truncate or conic-reversed form. Such is

Chrysomela sanguinolenta [a common British species], four lines long, black or blue-black, with the sides of the thorax thickened, and the elytra with a broad margin of red. It is found on the earth in fields, at the sides of oot-paths.

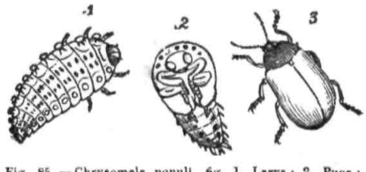

Fig. 85. — Chrysomela populi. fig. 1, Larva; 2, Pupa; 3, Imago.

Chrysomela populi, Linn., is blue, with red elytra, having a small black mark at the tip. It is found in the willow and poplar, on which its larva lives, often in society. [It is very abundant in England], and forms, with some others, the genus *Lina* of Megerle.

We finish this tribe with those Chrysomelinæ which have the maxillary palpi slender at the tips, and terminated in a point.

Phædon, Meg. (and *Colaphus*, Meg.), have the body ovoid or orbicular.

Prosocuris, Latr. (*Helodes*, Fabr.), has the body narrow, more elongated, and the terminal joints of the antennæ form a straight mass. [*P. phellandrii*, a common British species. Several other subgenera have been separated by recent authors, and of which the British species are described by Mr. Stephens, in his *Illustrations of British Entomology*.]

The third and last tribe of the Cyclica, *Galerucitæ*, has the antennæ always at least as long as half the body, of equal thickness throughout, or gradually thickened to the tips, inserted between the eyes at a little distance from the mouth, and generally close together at the base, and near to a small longitudinal elevated line; the maxillary palpi, thickened in the middle, are terminated by two joints in form of a cone, but united together at the base, the last being short, and either truncated, obtuse, or pointed; the body is either ovoid or oval, and sometimes nearly hemispherical. Many, especially amongst the smaller species, have the hind thighs thickened, which gives them the power of leaping.

This tribe is composed of the genus

GALERUCA,—

Which we divide into two principal tribes—those which do not leap, *Isopoda* [having equal-sized feet], and those which leap, *Anisopoda*, [or having unequal-sized feet].

Adorium, Fabr. (*Oides*, Weber), is composed of exotic species having the penultimate joint of the maxillary palpi dilated, and the last much shorter, and truncate.

Luperus, Geoff., has the last two joints of the maxillary palpi scarcely differing in size, and the antennæ composed of cylindrical joints as long as the body. [Small British species.]

The others, which have the palpi terminated in the same manner, and the antennæ shorter, and composed of reversed-conical joints, are the

Galeruca proper [composed of numerous species, including] *Chrysomela Tanaceti*, Linn., which is oval-oblong, black, but slightly shining, and with the elytra strongly punctured. It lives on the tansy.

The Saltatorial Galerucitæ, or those which have the posterior thighs thickened, arranged by Fabricius in his genera *Chrysomela*, *Galeruca*, and *Crioceris*, are reunited into a single genus (*Haltica*), in the systems of Geoffroy, Olivier, and Illiger. These beetles are very small, but adorned with varied and brilliant colours, and leap with great agility and to a great height when disturbed. They often devastate the leaves of such vegetables as serve them for food, their larvæ devouring the parenchyme, and undergoing their transformations within the leaf. Some species, especially those which have been called in France *puces des jardins*, Garden-fleas [and in England Turnip-fleas], do much damage in the two states [of larva and imago], to pot-herbs, [and especially to turnips just sprung up.] South America is the country which, above all others, abounds with the greatest number of these insects. Illiger has published, in his *Entomological Magazine*, an excellent monograph on these insects, which he has distributed into nine families, some of which appear to us to form distinct subgenera.

Octogonotes, Drapiez, differs from all the rest in having the maxillary palpi with the third joint swollen, and the last very short and truncate; the labial are terminated in a point, as in the following subgenera, but in these the maxillary palpi are similarly terminated, or subulated at the tip. The last joint of the hind tarsi of Octogonotes is suddenly swollen and rounded above, with the claws very small.

Œdionychus, Latr., differs from all the following by possessing the last-mentioned character, and includes the first two families of Illiger. The only European species is *A. marginella*, Olivier, found in Spain and Portugal.

In the following subgenera, the last joint of the hind tarsi is gradually thickened, and terminated by two ordinary-sized claws.

Psylliodes, Latr., has the first joint of the hind tarsi very long, inserted above the posterior extremity of the tibia, which is produced into a conical appendage, compressed, toothed at its edges, and terminated by a small tooth. It corresponds with Illiger's ninth family *Altitarses*. *H. chrysocephala*, &c.—*H. dentipes*, *aridella*, &c., having the posterior tibiæ dilated in the middle into a tooth, form another subgenus.

Dibolia, Latr. (previously *Altitarsus*, Latr.), has the head for the most part received into the thorax, and the posterior tibiæ terminated by a furcate spine. (Illiger's eighth family, *A. echii*, Oliv., &c.)

Altica, Latr., has the head exposed, the posterior tibiæ truncate at the tips, without any prolongation or fork, and the tarsi terminal and short. Type, *Chrysomela oleracea*, Linn. [and numerous other British species, arranged by Stephens into several new subgenera, forming Illiger's third, fourth, fifth, and sixth families.]

Longitarsus, Latr., has all the characters of Haltica proper, but the posterior tarsi are at least as long as the posterior tibiæ. (Illiger's seventh family.)

THE SEVENTH FAMILY OF THE COLEOPTERA TETRAMERA,—

THE CLAVIPALPI,—

Is distinguished from all the others of the same section, which, like these, have the underside of the three basal joints of the tarsi furnished with cushions beneath, and the third joint bilobed, (the terminal joint also having a node at its base, which is also observed in the Coccinellæ,) by having their antennæ terminated by a very distinct and perfoliated mass, and by their maxillæ being armed on the inner edge with a horny tooth ; in a few, the tarsi are entire, but they recede from the other Tetramera which have similar tarsi, by having the body nearly globular, and contractile into a ball. The body is often of a rounded form, generally very gibbose and hemispherical, with the antennæ shorter than the body ; the mandibles notched or toothed at the extremity ; the palpi terminated by a much thicker joint ; the last joint of the maxillary palpi being very broad, compressed, and nearly crescent-shaped. The form of the organs of the mouth indicates that the species are not carnivorous : the indigenous species are, in fact, found in fungi growing on the trunks of trees, beneath the bark, &c.

They may be reunited into the single genus

EROTYLUS, Fabr.—

Some of which have the the maxillary palpi terminated by a large hatchet- or crescent-shaped joint.

Erotylus proper (including *Ægethus*, Fabr.), has the intermediate joints of the antennæ subcylindric, and the club of the antennæ formed of the terminal joints, oblong ; the inner and corneous lobe of the maxillæ having two teeth. The species are confined to South America. [They are very numerous, a considerable number having been described by M. Godart in his monograph on this genus.]

Triplax (and *Tritoma*, Fabr.), differ in having the antennæ submoniliform, and terminated by a shorter ovoid club, and by the maxillæ having a single small tooth on the inner edge. In *Tritoma*, the body is nearly hemispherical—*T. bipustulatum* [a small British species, of rare occurrence on fungi],—and in *Triplax*, the body is oval, or oblong. [Several small British species.] The others have the last joint of the maxillary palpi elongated, and more or less oval.

Languria, Latr., has the body linear, and the club of the antennæ [3- to] 5-jointed. [Exotic insects, having somewhat the appearance of Elateridæ.]

Phalacrus, Payk. (*Anisotoma*, Illig.), has the body sub-hemispherical, and the club of the antennæ only 3-jointed. The species [are very numerous, and of small size. They are found upon flowers, and beneath the bark of trees].

Agathidium, Illig. (*Anisotoma*, Fabr.), differs from all the rest of the family by having all the joints of the tarsi simple, and the body nearly globular. [Minute British species.]

The fourth section of the Coleoptera, that of the TRIMERA, has only three [ordinary-sized] joints in the tarsi ; [a fourth, however, but very minute, exists at the base of the last or fourth joint]. They compose three families ; those of the first two are closely allied to the last of the Tetramera. Their antennæ, always composed of eleven joints*, are terminated by a club formed of the last three, compressed, and of a conical or reversed triangular form. The basal joint of the tarsi is always distinct ; the second joint ordinarily bilobed, and the last, presenting a knot at its base, is always terminated by two ungues ; the elytra entirely cover the abdomen, and are not truncated. The last of the Trimera, or the third family, approach in this respect, and in many other characters, the pentamerous Brachelytra, and some others of the same section, such as *Mastigus*, *Scydmænus*, and have habits very different from those of the other Trimera.

THE FIRST FAMILY OF THE COLEOPTERA TRIMERA,—

THE FUNGICOLÆ,—

Have the antennæ longer than the head and thorax ; the body oval, with the thorax trapezoid ; the maxillary palpi filiform, or rather thickened at the tips, but not terminated by a very large hatchet-shaped joint ; the penultimate joint of the tarsi is always deeply bilobed. This family may be reduced to the single genus

EUMORPHUS,—

Some of which have the third joint of the antennæ much longer than the preceding and following. Such are

Eumorphus, Weber, which has the club of the antennæ suddenly formed, solid, and very compressed ; the max-

* I, however, only count nine in Clypeaster, but from the smallness of those insects, I may have fallen into some error.

illary palpi are filiform, and the two terminal joints of the labial palpi form, when united, a triangular mass. They inhabit India and America.

Dapsa, Zeigl., has the antennal club narrow, elongated, with the joints apart at the side. [Exotic species.]

The others have the third joint of the antennæ scarcely longer than the adjoining joints. Many of the species are indigenous [to France and England], and live in Lycoperdons, or beneath the bark of trees.

Endomychus, Weber, has the four palpi thicker at the tips; the last three joints of the antennæ apart at the sides, longer than the preceding, and forming a reversed triangular mass. [*E. coccineus*, a pretty little English species.]

Lycoperdina, Latr., has the maxillary palpi filiform; the last joint of the labial larger than the preceding, and the two last joints of the antennæ forming a reversed triangular club. *L. Bovistæ*, [a small British species, found in puff-balls].

THE SECOND FAMILY OF THE COLEOPTERA TRIMERA,—

THE APHIDIPHAGI,—

Is composed for the most part of insects of a hemispherical form; the thorax very short, transverse, almost crescent-shaped; the antennæ terminated by a compressed mass in the form of a reversed cone, composed of the three terminal joints, and shorter than the thorax; the last joint of the maxillary palpi is very large, hatchet-shaped; and the second joint of the tarsi deeply bilobed. In the other Trimera, of the same family, the joints of the tarsi are simple, or the second is but slightly bifid, a character which, with some others, distinguishes these insects from the Fungicolæ.

Some have the body more or less thick, and never flattened and shield-shaped; the thorax transverse; the head exposed; the antennæ distinctly 11-jointed; the terminal joints forming a reversed conical club.

These insects compose the genus

COCCINELLA.

Lithophilus, Frohl., has the body ovoid, with the thorax strongly margined at the sides and narrowed behind, with the second joint of the tarsi very slightly bifid. *L. ruficollis*, Dahl. [a minute European species].

Coccinella proper, has the body nearly hemispherical; the thorax very short, nearly crescent-shaped, scarcely margined; and the second joint of the tarsi deeply bilobed.

Many species of this genus are widely dispersed upon trees and plants in our gardens, and enter our houses; they are well known under the name of *Lady-birds*, or *Lady-cows*. The generally hemispherical form of their bodies, the number and arrangement of the spots on their elytra, which resemble a kind of inlaid work of black upon yellow or orange, or vice versâ, as well as the agility of their motions, cause them to be easily known. They are the first to appear in the spring; when seized, they fold up their legs against the body, and emit a mucilaginous humour from the joints of the legs, as in the Chrysomelæ, and which is of a yellow colour and very disagreeable scent. They feed upon plant-lice, as well as their larvæ, of which the form and metamorphoses closely resemble those of the Chrysomelinæ. Occasionally, individuals, differing greatly from each other, are found coupled together, but the results of such unions have not been observed.

Fig. 86.—Coccinella 7-punctata.

Coccinella 7-punctata, the common Lady-cow, is about three lines long; black, with the elytra red, with three black dots on each, and one in the middle. It is the commonest species in this country, as well as in France.

Clypeaster, Andersche, (*Cossyphus*, Gyll.), has the body very flat and shield-shaped, with the head hidden beneath a nearly semicircular thorax; the antennæ do not distinctly possess more than nine joints; the joints of the tarsi are entire, and the prosternum forms a kind of cravat beneath the mouth. [The species are of very minute size], and are found beneath the bark of trees, and under stones.

THE THIRD FAMILY OF THE COLEOPTERA TRIMERA,—

THE PSELAPHI,—

Has the elytra short and truncated, covering only a part of the abdomen, thus possessing a certain resemblance to the Brachelytra, and especially to the Aleocharæ; this last part of the body is, however, much shorter, broad, very obtuse, and rounded behind; the antennæ, terminated in a club, or thickened to the tips, sometimes formed of only six joints; the maxillary palpi are ordinarily very large; all the joints of the tarsi are entire, and the first is much shorter than the following, and scarcely visible at first sight; the last is often terminated by a single unguis.

These insects are found on the ground, under the debris of vegetables, and some inhabit ants' nests. [By English entomologists, this extremely interesting family, placed by Latreille at the end of the order Coleoptera (on account of the structure of the tarsi exhibiting a greater simplicity than that of any other Beetles), is arranged in immediate connexion with the Staphylinidæ. The monographs of Reichenbach, Denny, and Leach, and the more recent works of Aubé, Stephens, and Erichson, have

made us acquainted with a great number of species, and some new genera, of this minute and curious tribe.]

Those which have eleven joints to the antennæ form the genus

PSELAPHUS, Herbst.

Some, few in number, have two ungues to the tarsi.

Chennium, Latr., has the ten basal joints of the antennæ equal-sized, and the palpi not exserted. *C. bituberculatum*, [a continental species].

Dionix, Dej., has the third and four following joints of the antennæ very minute; the eighth and three following thicker than the preceding, and as long as the seven preceding together; the maxillary palpi exserted, and the labial palpi short, stretched forwards, and 3-jointed, with a point at the tip.

The others have but a single tarsal unguis, and some of these have the maxillary palpi very long and elbowed, the second and fourth joints being especially elongated.

Pselaphus proper, differs from the two following by having the antennæ evidently longer than the head and thorax, and terminated by a club formed of the last three joints, which are evidently longer than the preceding. [*Ps. Herbstii*, and several other British species.]

Bythinus, Leach (having the second joint of the antennæ thick and dilated into a lateral tooth—*Ps. securiger*, Reich.), and

Arcopagus, Leach (having the second joint of the antennæ slender, and the basal one sometimes dilated—*Ps. glabricollis*, Leach), have the ninth and tenth joints of the antennæ scarcely thicker or larger than the preceding, but the eleventh very large.

In others the maxillary palpi are shorter than the head and thorax, and the fourth joint, at least, is short, and ovoid or triangular.

Ctenistes, Reichenb., has the three terminal joints of the maxillary palpi armed with a tooth of the outside. [*Ct. palpalis*, a continental species.]

Bryaxis, Leach (and *Euplectus* and *Tychus*, Leach), have the maxillary palpi of the ordinary form, the last joint longer, conical, or hatchet-shaped; the thorax is short, and scarcely longer than broad; the form of the last joint of the palpi and of the joints of the antennæ, although offering good characters, does not appear sufficiently important for the establishment of [Leach's] genera.

The terminal Pselaphiens have the antennæ composed of only six joints, or are even inarticulate.

CLAVIGER.

Claviger proper has distinctly 6-jointed antennæ, the eyes appear wanting, and the maxillary palpi are very short. The species are found under stones, and in the nests of small yellow Ants. [*Claviger faveolatus*, a minute species, first detected by me in England in 1838, in Whychwood Forest, Oxfordshire.] See the monographs of Germar in the third volume of his *Magasin der Entomologie*, Aubé, Gyllenhall, [and particularly the recently published memoir of Schmidt.]

Articerus, Dalm., has the antennæ apparently composed of a single joint, forming a long cylinder, truncated at the tip; the eyes are distinct. *A. armatus*, observed by Dalman in gum copal.

Note.—The tarsi of *Dermestes atomarius*, De Geer, having appeared to M. Leclerc de Laval to be composed of only a single joint, we had formerly established for its reception a new primary section of the Coleoptera, which we had thence named MONOMERA. Fischer adopted this section, giving the generic name of *Clambus* to the insect; Schuppell had also proposed for it that of *Ptilium*; M. Gyllenhall has, however, reunited the species to *Scaphidium*, and, in fact, we consider that this new genus ought to be placed near that genus; the section Monomera must, therefore, be suppressed. [Having carefully examined these minute insects, I am able to state that their tarsi consist of several joints.]

THE SIXTH ORDER OF INSECTS,—

ORTHOPTERA, (ULONATA, Fabr.), [DERMAPTERA, De Geer],—

United, for the most part, by Linnæus with the Hemiptera, and by Geoffroy with the Coleoptera, but forming a peculiar division, exhibit a body generally less firm than the last mentioned order; soft, semimembranous, wing-covers much nerved, and not uniting at the suture in a straight line; wings folded longitudinally, and often fan-like, divided by transverse nervures; maxillæ always terminated by a corneous denticulated piece, and covered by a galea, corresponding with the outer division of the maxillæ of the Coleoptera; and lastly, a kind of tongue, or epiglottis.

The Orthoptera are insects* which undergo a semicomplete metamorphosis, all the changes being reducible to the increase and developement of wing-covers and wings, which begin to appear under a rudimentary form in the pupa. This pupa and the larva resemble the perfect insect in other respects, walking and feeding in the same manner.

The mouth of the Orthoptera is composed of a labrum, two mandibles, two maxillæ, and four palpi; those of the maxillæ have always five joints; the labial palpi, as in the Coleoptera, have only three. The mandibles are always very strong and horny; the tonguelet is constantly divided into two or four plates. The form of the antennæ varies less than in the Coleoptera, but they are generally composed of a much greater number of joints. Many, in addition to the composite eyes, have two or three ocelli. The under-side of the basal joints of the tarsi is often fleshy, or membranous; the basal joint in the Grasshoppers with short antennæ, presents three lobes, or divisions, on the under-side. [In these insects, however, the tarsi consist but of three joints; these lobes, therefore, indicate the other two joints, which are evidently soldered with the first.] Many females are furnished with a real borer, formed of two plates, for depositing their eggs, which are often covered by a common envelope. The posterior extremity of the body is generally armed with appendages.

The intestines of the larvæ resemble those of the perfect insects.

All the known Orthoptera are, without exception, terrestrial, both in their perfect and two previous states. Some are carnivorous, or omnivorous; but the greater numbers feed upon living plants. The species which inhabit our climate have but a single generation in a year, the eggs being deposited towards the end of the summer. This is also the period of their last transformation.

We divide the Orthoptera into two great families, [*Cursoria* and *Saltatoria*], a mode of distribution confirmed by their anatomy; the insects of the first having only tubular tracheæ, whilst those of the second have vesicular tracheæ. [We are indebted to M. Serville for a revision of the generic division of this order, published in the *Annales des Sciences Naturelles*. Dr. Burmeister, in 1838, also worked out the order, adding many new genera, in his *Handbuch der Entomologie*. In 1839, M. Serville, unacquainted with Burmeister's work, published his *Histoire Naturelle des Insectes Orthoptères*, in which he introduced many new genera, as well as some established by Burmeister, but with other names; which of course must rank as synonymes. Dr. Burmeister has just published, in the third number of Germar's *Zeitschrift der Entomologie*, a revision of these two works, with a view of pointing out the synonymes.]

In the first family all the legs are alike, and solely fitted for running; in the second, the thighs of the hind legs are much larger than those of the other feet, which gives them the power of leaping; the males, moreover, make a sharp noise, or a kind of stridulation. These are the leaping, or musical Orthoptera.

THE FIRST FAMILY OF THE ORTHOPTERA,—

THE CURSORIA,—

Has the hind legs solely fitted, like the others, for running. They have generally the wing-covers and wings resting horizontally on the body; the females do not possess a horny ovipositor. These form three genera, [*Forficula*, *Blatta*, and *Mantis*]. The first, that of

THE EARWIGS (*Forficula*, Linn.),—

Has three joints to the tarsi, the wings folded like a fan, and shutting up transversely beneath crustaceous wing-covers, which are very short, and meet in a straight suture; the body is linear, with two large scaly moveable appendages, which form a forceps at the posterior extremity of the body. The head is exposed; the antennæ are filiform, inserted in front of the eyes, and composed of from twelve to thirty joints, in different species. The galea is slender, elongated, and nearly cylindrical

* This order, the Lepidoptera and Strepsiptera, and the apterous hexapod insects, do not possess any aquatic species

the tonguelet is furcate; the thorax is plate-like. The second joint of the tarsi is simply dilated beneath, near the tip, or in form of a reversed heart, and not notched. These insects have been very carefully investigated in respect to their internal anatomy, by Messrs. Ramdohr, Posselet, Marcel de Serres, and especially by Léon Dufour, in the *Annales des Sci. Nat.*, vol. xiii. From their anatomical characters they appear to L. Dufour to constitute a distinct order, which he names *Labidoures.* Mr. Kirby had also previously proposed the name of *Dermaptera* for them as an order.*

These insects are very common in damp situations, where they often assemble in troops under stones, and the bark of trees; they do much injury to the fruits of our gardens, [devouring also the petals of flowers], as well as the bodies of their dead companions, defending themselves with their forceps, of which the form varies according to the sex. It is a vulgar notion that they creep into the ear of sleeping persons; this, however, is the origin of their French name, *Perce-oreille* [English name, *Earwig*; German name, *Ohrwurm*, &c.]

[The species has been distributed into a considerable number of subgenera by Leach, Serville, and Burmeister.] Latreille divides them, in a note, into

Forficula proper, which has not more than 14 joints to the antennæ.

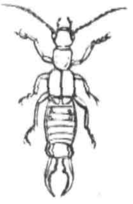

Fig. 87.—Forficula auricularia.

Forficula auricularia, is more than half-an-inch long, brown, shiny, with a reddish head, the sides of the thorax grey, and the feet yellow-ochre coloured. The female guards her eggs with much care, as well as her young, for a considerable time.

Forficula minor (the small Earwig), is much smaller, and has 11- or 12-jointed antennæ; it forms Leach's genus *Labia*.

Forficesila, Latr., has more than 14 joints to the antennæ. [*F. gigantea*, the type of Leach's genus *Labidura*, with 30 joints to the antennæ.]

Chelidura, Latr., is wingless.

The second genus, that of

BLATTA, Linn.,

Has five joints to all the tarsi; the wings are only folded longitudinally; the head hidden beneath the large plate of the prothorax, and the body is orbicular, or oval, and flattened.

The antennæ are filiform, inserted in an inner notch of the eyes, long, and composed of a very great number of joints; the palpi are long; the prothorax shield-like; the wing-covers are ordinarily as long as the abdomen, coriaceous or semimembranous, and crossing each other slightly at the suture. The posterior extremity of the abdomen presents two conical and articulated appendages; the tibiæ are very spinose.

The Blattæ [or Cockroaches] are nocturnal insects, exceedingly active, some living in the interior of our houses, especially kitchens, bake-houses, and corn-mills. Others are found in the country. They are very voracious, consuming all kinds of provisions. The species found in the French colonies are there termed Kakerlacs, and greatly annoy the inhabitants by the mischief they commit, attacking not only eatables, but gnawing also woollen and silk materials, and even shoes; they will also eat other insects. Some species of Sphex make war upon them.

[The species are very numerous, and have lately been formed into a considerable number of genera by Serville and Burmeister; Latreille, however, retained them under the single genus *Blatta*.]

Blatta orientalis [the common Cockroach] is an inch long; the male is furnished with wings shorter than the abdomen; the female has only short rudiments. The eggs, 16 in number, are symmetrically arranged in an oval compressed case, which is at first white, but subsequently brown and solid, denticulated on one side; the female carries it about with her for some time at the extremity of the body; she then attaches it to various substances by means of a gummy secretion. This species is a scourge both to the inhabitants of Russia and Finland. It has been supposed to have come from South America, whilst others give Asia as its native country.

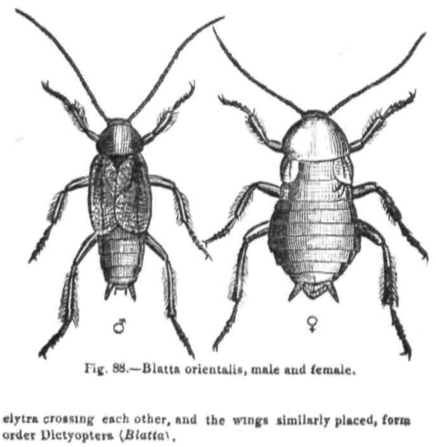

Fig. 88.—Blatta orientalis, male and female.

* Dr. Leach divided the other Orthoptera into two other orders. Those with the wings folded longitudinally, and with the wing covers meeting in a straight line, were his Orthoptera; and those with the elytra crossing each other, and the wings similarly placed, form order Dictyoptera (*Blatta*).

Blatta lapponica, devours the cured fish which the Laplanders have provided for their sustenance, in lieu of bread. In our country it inhabits woods, [which leads to the suspicion that the species thus named are not identical]. M. Hummel has published a series of very interesting observations on *Blatta germanica*, in his *Essais Entomologiques*.

The third genus, that of

MANTIS, Linn.,—

Has also five joints in all the tarsi, and the wings simply folded longitudinally, but the head is exposed, and the body long and narrow; the palpi are also short and pointed, and their tonguelet quadrifid.

These insects are found only in temperate or hot climates, and reside upon trees or plants, often resembling their leaves or twigs in the form and colour of the body, and seeking the full sun-light. Some are rapacious, whilst the others are herbivorous. The eggs are ordinarily inclosed in a capsule of a gummy secretion, which hardens in the air, and is divided internally into a number of cells, and is sometimes in the form of an oval cocoon, sometimes like a pod with angles, and sometimes spined. The female fastens it to plants, or other substances elevated from the ground.

Some have the two fore-legs much larger and longer than the others, with the coxæ long, the thighs very strong, compressed, and armed beneath with spines, the tibiæ curved, and terminated by a strong hook; they have ocelli distinct, and close together in a triangle; the first segment of the thorax is very large; the four lobes of the tonguelet of nearly equal length; the antennæ inserted between the eyes, and the head triangular and vertical.

These species are carnivorous, seizing their prey with the fore-feet, which they elevate in front of the body, and quickly folding the tibiæ upon the under-side of the femur [which thus becomes a most powerful raptorial instrument, not only fitted for capturing the prey, but also exactly formed for conveying it to the mouth]. The eggs are very numerous, and are inclosed in the same number of cells disposed in regular series, and united in an ovoid mass or cocoon.

[These Orthoptera, which are very numerous, have been distributed by Serville and Burmeister into a great number of genera, founded mostly upon external characters of form.] Latreille, however, retains them in the single subgenus

Fig. 89.—Mantis, in the act of seizing a fly, with a young one just hatched.

MANTIS proper, restricting it, however, to those which have no frontal horn on the head.

Mantis religiosa, Linn. (the Praying Mantis, or Sooth-sayer), is regarded by the Turks as an object of religious respect. Another species is still more venerated by the Hottentots. The former is very common in the south of France and Italy. See the work of Stoll, and the memoir of Lichtenstein, in the *Transactions of the Linnean Society*, [also the works of Serville and Burmeister].

Those species which have the forehead prolonged into a horn, with the antennæ of the males pectinated, form the genus *Empusa*, Illiger.

The others have the fore feet similar to the hind ones; the ocelli very indistinct, or wanting; the first segment of the thorax shorter, or of the same length as the following; the interior divisions of the tonguelet shorter than the lateral; the antennæ inserted in front of the eyes, and the head nearly ovoid, porrected, with the mandibles thick, and the palpi compressed. These insects are of very singular form, and resemble either the twigs or leaves of trees. They appear to feed only on vegetables, and, like many of the Grasshoppers, their colours resemble those of the plant on which they ordinarily reside; the two sexes often differ very widely from each other.

They form the subgenus

SPECTRUM, Stoll,—

Which has been divided into two others.

Phasma, Fab., comprises the species which have the body filiform or linear, similar to a stick, many of which are entirely destitute of wings, or have the wing-covers very short. Many large species are found in the Moluccas, and South America. *P. Rossia*, Fab., inhabits the South of France.

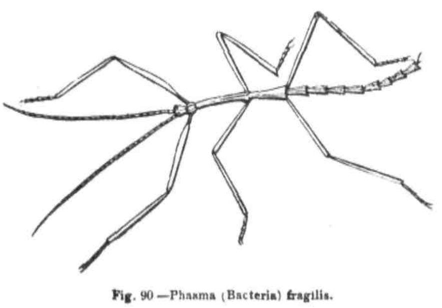

Fig. 90.—Phasma (Bacteria) fragilis.

Phyllium, Illig., has the body very flat and membranous, and the feet furnished with broad membranes,

Mantis siccifolia [or the Walking Leaf], a species peculiar to the Sechelles Islands, Mauritius, &c., of which the female has very short antennæ, with the wing-covers as long as the abdomen, but destitute of wings; the male is much narrower, with long filiform antennæ; short wing-covers, and wings as long as the abdomen.

[Latreille, in the *Familles Naturelles*, Saint Fargeau and Serville, in the *Encyclopédie méthodique*, the latter in his *Histoire naturelle des Insectes Orthoptères*, and Gray in his *Synopsis of Phasmidæ*, have constituted a great number of generic groups detached from those given above, and which are founded upon the variations in the developement of the wings in the different sexes; the proportions of the thoracic segments, antennæ, &c. Messrs. Burmeister and Brullé have considerably reduced the number of these groups in their works upon this order.]

THE SECOND FAMILY OF THE ORTHOPTERA,—

THE SALTATORIA,—

Has the two hind feet remarkable for the size of their thighs, and for the very spined tibiæ thus formed for leaping. The males call their females by making a chirping noise, which is sometimes produced by rubbing an inner part of the wing-covers like a talc-like mirror, against each other with rapidity, and sometimes by a similar alternate motion of the hind thighs against the wings and wing-covers, the thighs acting the part of the bow of a violin. The majority of the females lay their eggs in the ground.

This family is composed of the genus

GRYLLUS, Linn.,—

Which we divide as follows :—

Some have the organ of sound in the males consisting of an inner part of the wing-covers in the shape of a mirror; the ovipositor of the females is very long, exserted, and often sabre-shaped, and the antennæ are either very long and slender at the tips, or of equal thickness throughout, but very short.

In some of these, the wings and wing-covers are horizontal, the wings when folded up in repose forming long filaments, extending beyond the wing-covers, and the tarsi have only three joints, as in the genus

GRYLLUS, Geoffroy & Oliv. (*Acheta*, Fabr.), [and *Achetidæ* of English authors].

They live in burrows, and ordinarily feed upon insects; many are nocturnal. They form four subgenera.

Gryllotalpa, Latr., having the tibiæ and tarsi of the two fore-legs very broad, flat, and toothed, like hands proper for burrowing; the other tarsi of the ordinary form.

Gryllotalpa vulgaris [the Mole-cricket], is an inch and a half long, and of a brown colour. It is too well known from the injuries it commits in gardens and cultivated fields, living in the earth, where its fossorial fore-legs, like those of a Mole, enable it to form a burrow. It cuts or detaches the roots of plants, but less with the intention of feeding upon them as to form a passage, for it feeds, as it would seem, upon other insects or worms. The song of the male, heard only in the evening or night, is soft, and not disagreeable. [It is thence, in some parts of England, called Chur-worm.] The female forms, in June and July, at the depth of about six inches, a subterranean rounded cell, smooth in the interior, in which she deposits from 200 to 400 eggs; the cell with its gallery resembles a bottle with a long bent neck. The young live for some time in society. See for further details the observations of M. le Feburier in the *Nouv. Cours d'Agriculture*. [From more recent observations, it appears certain that the Mole-cricket is obnoxious in gardens, &c., from its herbivorous habits. One species, *G. didactyla*, in the West Indies, does great injury to the plantations of young sugar canes. See, also, the work of Kollar on injurious insects, translated by Miss Loudon.]

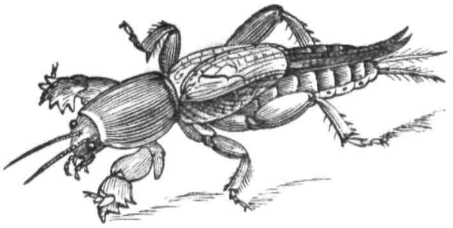

Fig. 91.—Gryllotalpa vulgaris.

Tridactylus, Oliv. (*Xya*, Illig.), are also fossorial in their habits, but only with the anterior tibiæ; the posterior tarsi are replaced by narrow, bent, moveable appendages; the antennæ are very short, and 10-jointed. Minute exotic insects. [The genus *Ripipteryx*, Newman, is closely allied to this genus.]

Gryllus proper [*Gryllus acheta* of Linnæus, *Acheta* of English authors], have not the feet fitted for burrowing, and the females have the ovipositor long and exserted; the antennæ are greatly elongated, pointed at the tip; the ocelli are indistinct. The Field-cricket, *Gryllus campestris*, Linn., and the common House-cricket, *G. domesticus*, belong to this genus. The first forms deep retreats in dry and hot situations, in which it stations itself to surprise other insects upon which it preys. The female deposits about 300 eggs; the House-cricket inhabits the interior parts of houses, especially in the neighbourhood of fire-places, in which it makes its burrows, and breeds. The male produces a harsh noise; that made by *G. megacephalus* can be heard at the distance of a mile.

Myrmecophila **(*Sphærium*, Charpent.), is destitute of wings, and has the body oval. *M. acervorum* is of very small size, and lives in Ants' nests [on the Continent].**

Others [having, like the last, a talc-like spot at the base of the wing-covers in the male], have these organs disposed like a roof, and the tarsi have four joints; the antennæ are very long and filiform. The females have the ovipositor always exserted, compressed, and sabre or cutlass-shaped. These insects are herbivorous, and form the genus

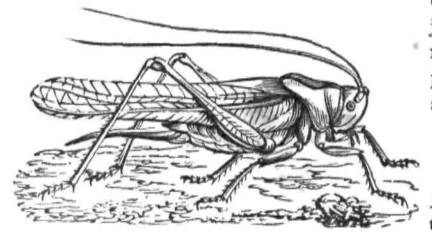

Fig. 92.—L. viridissima.

LOCUSTA, Geoffr. [*Gryllus*, or *Gryllidæ*, of English authors].

[The Great Green Grasshopper, with long antennæ], *L. viridissima*, is two inches long, green, without spots; the ovipositor of the female is straight.

Many species of this genus are destitute of wings, or have wing-covers only, but of very small size.

[The species of this genus, or rather, family, have been distributed into a considerable number of generic groups by Thunberg, Serville, Latreille, Burmeister, and others, founded upon external variations of form.]

The others have the antennæ filiform and cylindric, sword-shaped, or thickened at the tips, and as long as the head and thorax; the wings and wing-covers are roof-shaped when inactive, and the tarsi are 3-jointed. The tonguelet, in the majority, has only two divisions; the ocelli are three in number and constantly distinct; the mandibles much toothed; the abdomen conical, and compressed at th. sides. They leap with much more energy than the preceding, and have a much longer sustained flight. They feed upon vegetables with great voracity. They may be united into a single genus, that of

ACRYDIUM, Geoffr.,—

Which [has been greatly divided into genera and subgenera by Serville, Burmeister, and Thunberg, but which] Latreille divides as follows.

Some have the mouth exposed, the tonguelet bifid, and a membranous pulvillus between the tarsal ungues.

Pneumora, Thunb., has the hind-legs shorter than the body, and scarcely fitted for leaping; the abdomen is bladder-shaped in one of the sexes. These species are only found in the southern parts of Africa.

Proscopia, Klug, is wingless; the body is long and cylindrical; the head, without ocelli, is prolonged in front into a point or cone, bearing two very short 7-jointed antennæ, pointed at the tip; and the hind-legs are large and long. These insects are peculiar to South America, and have been well monographed by Klug.

Truxalis, Fab., has the antennæ compressed, and of a prismatic form; the head elevated into a pyramid. *Gryllus nasutus*, Lam., and many other exotic species.

Xyphicera, Latr. (*Pamphagus*, Thunb.), is composed of species which, in respect to their antennæ, are intermediate between Truxalis and the following genus.

Acrydium proper, *Gryllus*, Fab. (*Gryllus locusta*, Linn.), [*Locustidæ* of British authors], differs from Pneumora in having the hind feet longer than the body, the abdomen solid, and not bladder-like: and from Truxalis, in having the head ovoid, and the antennæ filiform, or terminated by a knot. Many species have on each side of the body, near the base of the abdomen, a large cavity, closed on the inside by a very thin pellicle. I have described this organ in the eighth volume of the *Mémoires du Muséum*, which has some influence either in the production of the chirping, or in flight. From analogy with the Cicada, I have compared it to a kind of tambour. The species fly high in the air, and often in troops. Their hind wings are often agreeably coloured, especially with red and blue. Amongst the exotic species the thorax is often crested, warty, or otherwise singularly formed. Certain species have been termed Migratory, from their uniting themselves in troops of incalculable numbers, and migrating through the air in thick clouds, and in an astonishingly short time transform the places where they alight into an arid waste. Their death even becomes a scourge, the air being infected by the immense masses of their dead bodies. M. Miot, in his excellent translation of Herodotus, conjectures that the mass of dead bodies of winged serpents which the historian relates to have seen in Egypt, was a mass of the bodies of these migratory locusts. This opinion perfectly accords with my own. These insects are consumed in different countries of Africa, the inhabitants using them for their own food, and as an article of commerce. They tear off the wings and wing covers, and then bake them. A great portion of Europe is often overrun by

Gryllus migratorius, which is two inches and a half long, with brown wing-covers spotted with black, and a slightly elevated crest on the thorax. The eggs are enveloped in a glutinous secretion, forming a cocoon, which the insect is said to fasten to plants. [This is, however, refuted by the observations of Mr. Smirnove upon the locusts of Russia, published in the *Transactions of the Linnæan Society of London*.] It is common in Poland.

The south of Europe, Barbary, Egypt, &c., suffer similar devastations from some other species, of which some are of larger size, as *G. ægyptius*, *tataricus*, Lam., &c., and which scarcely differ from *G. lineola*, Fab., which is found in the south of France; a species peculiar to the same countries, and which is that which is eaten and prepared in Barbary, in the manner above detailed. The natives of Senegal dry another species, of which the body is

yellow, spotted with black, and which Shaw and Denon have figured in the accounts of their voyages in Africa they then reduce them to powder, which they use as flour, as I learn from M. Savigny. These two species, and some others, have a conical prominence upon the prosternum, and compose the genus Acrydium. Amongst those which do not present this character, and in which the antennæ are equally filiform, some have the wing-covers and wings perfect in the two sexes, and belong to the genus which I have named *Œdipoda*. In this number are *G. stridulus*, *G. cærulescens*, [*G. flavipes*, and a great number of smaller species found in this country, usually called Grasshoppers, but distinguished by their shorter antennæ.]

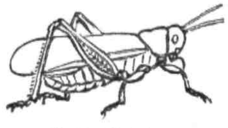
Fig 93.—G. flavipes.

Other Acrydia, similarly winged and with filiform antennæ, have the upper part of the prothorax strongly elevated, very compressed, forming a sharp crest, rounded and prolonged into a point behind. Foreign countries possess numerous species, one only of which, and of smaller size, is found in the south of France (*A. armatum*, Fischer.]

In the others, one of the sexes, at least, has the wing-covers and wings very short, and in no wise fitted for flight. I have formed for these a new generic group, named *Podisma*.

The Acrydia which have the antennæ thickened at the tips, either in both sexes or in only one of them, are formed also into a peculiar genus, *Gomphocerus*, by Thunberg. *G. sibiricus*, and other small British species.

In the second division of the genus Acrydium, the prosternum receives in a cavity a part of the under-side of the head; the tonguelet is quadrifid, and the tarsi have no pulvillus between the ungues; the antennæ have only 13 or 14 joints; the thorax is prolonged behind like a large scutellum, which is sometimes longer than the entire body, and the wing-covers are very small. These Orthoptera form the genus

Tetrix, Latr. (*Acrydium*, Fab., part of *Gryllus bulla*, Linn.), which is composed of very small species.

THE SEVENTH ORDER OF INSECTS,—

THE HEMIPTERA (RHYNGOTA, Fabr.),—

Terminate in our system the numerous division of insects furnished with wing-covers, and being the only ones among them which have neither mandibles nor maxillæ, properly so called, [that is, fitted for biting]. A tubular articulated tongue, cylindrical or conical in its form, curved downwards, or directed under the breast, having the appearance of a kind of rostrum; presenting throughout its whole upper face, when stretched forward, a gutter, or canal, out of which three scaly, stiff, slender, and pointed setæ may be withdrawn, and which are covered at the base by a tonguelet; these setæ form unitedly a sucker, resembling a sting, having for its sheath the tubular piece above described, and in which it is kept by means of the superior tonguelet [or labrum], situated at its base. The inferior seta is composed of two threads united into one at a short distance from their origin; thus the number of the pieces of the sucker is, in reality, four. M. Savigny considered that the two superior setæ, or those which are separate, represent the mandibles of the biting insects, and that the two threads of the inferior seta answer to the maxillæ (or rather, as it appears to me, to their terminal lobes, which in the Bees and Butterflies are transformed into an elongated filament); hence the lower lip is replaced by the tubular sheath of the sucker, and the triangular piece at the base becomes the labrum. The tonguelet, properly so called, also exists, and under a form analogous to that of the preceding piece, but bifid at the tip (see *Cicada*); the palpi are the only organs which have entirely disappeared, and vestiges of them are perceived in Thrips, [which, however, are now proved to belong to an order distinct from the present; palpi, small and inarticulate, also exist in some of the Hydrocorisæ].

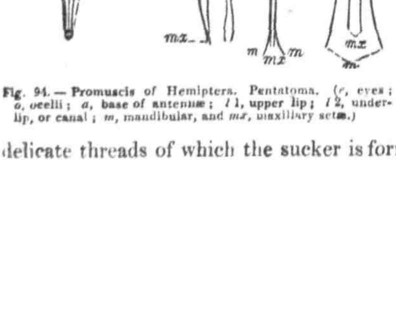

Fig. 94.—Promuscis of Hemiptera. Pentatoma. (e, eyes; o, ocelli; a, base of antennæ; l 1, upper lip; l 2, under-lip, or canal; m, mandibular, and mx, maxillary setæ.)

The mouth of the Hemiptera is, therefore, fitted only for extracting by suction fluid matters: the delicate threads of which the sucker is formed pierce the vessels of plants and animals, and the

nutritive fluid, successively compressed, is forced up the main canal, and arrives at the œsophagus; the sheath of the sucker is often elbowed, or forms an angle. Like other sucking insects, the Hemiptera possess salivary vessels.

In the majority of the insects of this order the wing-covers are coriaceous, or crustaceous, with the posterior extremity membranous, and forming, as it were, a kind of supplemental piece; they nearly always cross each other: those of other Hemiptera are merely thicker and larger than the hind wings, semi-membranous, like the wing-covers of the Orthoptera, and sometimes opaque and coloured, sometimes transparent and veined. The wings have several longitudinal folds.

The composition of the thorax begins to exhibit the modifications which we meet with in the following orders. Its anterior segment, hitherto known under the name of corselet [thorax, or more strictly, prothorax], is in many of much less extent, and is incorporated with the second, which is equally exposed.

Many possess ocelli, but their number is generally only two.

The Hemiptera [like the Orthoptera] exhibit to us, in their three states, the same forms and habits. The only change they undergo consists in the developement of wings, and an increase in the size of the body.

I divide the order into two sections [*Heteroptera* and *Homoptera*, regarded as distinct orders by many English authors, under the names of *Hemiptera* and *Homoptera*].

In the first section, *Heteroptera*, the rostrum arises from the front of the head, the wing-cases are membranous at the extremity, and the first segment of the thorax is much longer than the others, and forms by itself the corselet.

The wing-covers and wings are always horizontal, or slightly inclined.

This section is composed of two families [*Geocorisæ* and *Hydrocorisæ*]. The first,

GEOCORISÆ (or Land-bugs),—

Have the antennæ exposed, longer than the head, and inserted between the eyes, near their inner margin; the tarsi have [generally] three joints, the first of which is often very short. They form the genus

CIMEX, Linn.,—

Some of which, *Longilabres*, have the sheath of the sucker composed of four distinct and exposed joints; the upper lip is considerably prolonged beyond the head, like an awl, and transversely striated on the upper side; the tarsi have always three distinct joints, the first equal in length to, or longer than the second. These species emit, in general, a very disagreeable scent, and suck other insects. Sometimes the antennæ, always filiform, are composed of five joints; the body is generally short, oval, or rounded.

SCUTELLERA, Lam.,—

In which the scutellum covers the abdomen. *Cimex lineatus*, Linn. [a reputed British insect].

Pentatoma, Oliv., in which the scutellum covers only a portion of the upper-side of the abdomen. This genus, as proposed by Olivier, comprises five others in the *Systema Rhyngotorum* of Fabricius; but his groups are imperfectly characterized and badly arranged. His genera *Ælia* and *Halys* are Pentatomæ, which have the head more prolonged, and advanced in front like a snout, more or less triangular. The type of the former is *Ælia acuminata* [a rare British species], which differs from the rest in having the antennæ covered at the base by the anterior and detached margin of the under-side of the thorax, and by the scutellum of much larger size, whereby this species more nearly approaches Scutellera. His genus *Cydnus* has the head seen from above, broad, semicircular; the thorax transversely square, scarcely narrower in front than behind, and the tibiæ are often spinose. These species are found on the ground; some other species may also be united, which have the sternum neither keeled nor spined: such are *Cimex ornatus* and *oloraceus*, [handsome rare British species, forming Hahn's genus *Eurydema*].

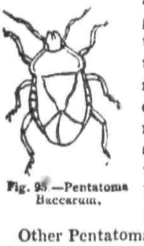

Fig. 95.—Pentatoma Baccarum.

Other Pentatomæ, having the mesosternum elevated in the manner of a keel, or exhibiting a point like a spine, are generically distinguished under the name of *Edessa*, employed by Fabricius. Many of the species which he introduces into this genus possess this character, which is also found in some of his species of Cimex, as *P. hæmorrhoidalis*, Linn. [the type of Curtis's genus *Acanthosoma*, and *P. griseus*, the type of Laporte's genus *Raphigaster*].

The female of the last-named species protects her young with great care, leading them about as a hen does her chickens.

Heteroscelis, Latr., is formed for the reception of a species from Cayenne, having the head cylindrical, the anterior tibiæ broad and palette-like.

Canopus, Fabr., as shown by the recent observations of M. Alexandre Lefebvre, is composed of small South American insects, not yet arrived at their full developement, having the body rather compressed, and very convex above, concave beneath, and the ocelli, as well as the wings, wanting].

[The preceding insects form the family *Pentatomidæ*, Leach; *Pentatomites* and *Scutellerites*, Laporte; and *Scutati*, Burmeister. The number of genera into which they have been divided by these authors, as well as by Hahn, in his *Die Wanzenartigen Insecten*, is very greatly increased, and has probably been carried too far.*]

Sometimes the antennæ have only four joints, and the body is ordinarily oblong. In some of these the antennæ are filiform or clavate.

Some exotic species approach the preceding in the general form of the body, being rather ovoid than oblong, and are distinguished from all the following by being either very flat, membranous, with the margins very strongly dilated and angular, or by having the prothorax posteriorly prolonged into a truncated lobe, and the sternum cornuted. Such is

Tesseratoma, Lepel and Serv. Type, *Edessa papillosa*, Fab.

Dinidor, Latr., has similarly 4-jointed antennæ, but the thorax is not posteriorly lobed. (*Edessa obscura, mactans*, &c.)

Phlæa, Lep. and Serv., is quite flat and membranous, with the sides of the body dilated and angular, the anterior extremity forming a flattened, truncated hood, hiding the antennæ, which are very short, apparently 3-jointed, and elbowed. [*P. corticata*, a singular Brazilian insect.]

All the others have the body generally oblong, and do not exhibit such characters as the last group. Some of these have the antennæ inserted near the lateral and superior margin of the head; the ocelli are close together, or at the same distance apart as they are from the eyes.

Coreus, Fab., has the body oval; the last joint of the antennæ ovoid or fusiform, often thicker and not longer than the preceding. *C. marginatus*, Geoff. [a common English species]. From the proportions of the joints of the antennæ the species may be thus subdivided. *Gonocerus*, with the third joint of the antennæ compressed and angular at the sides,—*C. sulcicornis, insidiator*, &c.; *Syromastes*, with the third joint of the antennæ simple, and longer than the fourth,—*C. marginatus*, &c.; *Coreus*, with the last joint of the antennæ much longer than the fourth, and compressed,—*C. hirticornis*, &c.

Holhymenia, Lep. and Serv., has the second and third joints of the antennæ plate-like. [Exotic species.]

Pachylis, Lep. and Serv., has the third joint alone of this form.

Anisoscelis, Latr., has the antennæ filiform, without dilatation; some have the posterior tibiæ with a broad membrane,—*L. membranaceus*, F., &c. The others, *L. valgus*, &c., have not, [but the hind femora are often grotesquely thickened. These are exotic species of large size.] Some of the species, with long slender antennæ, form my genus *Nematopus*.

Alydus, Fab., has the body long and narrowed; the eyes prominent; the ocelli close together, and the thorax slightly broader behind. [*A. calcaratus*, a rare British species].

Leptocorisa, Latr. [part of *Gerris*, Fab.], has the body long and filiform; the antennæ and legs are also greatly elongated, and the former straight.

Neides, Latr. (*Berytus*, Fab.), has the antennæ elbowed. [Small singular insects, three or four species of which occur, but rarely, in this country. *C. tipularius*, Linn.]

We now pass to the *Geocorisæ* which have the antennæ similarly filiform, or thickened at the tips, and 4-jointed, but inserted lower than in the preceding; the ocelli are close to the eyes, and the apical membrane of the hemelytra has only four or five nerves. [These form the family *Lygæidæ*.]

Lygæus, Fabr., has the head narrower than the thorax, which is narrowed in front,—*C. equestris*, Linn. *C. apterus*, Linn.; red, with the head, a spot on the thorax, and two on the hemelytra, black; the wing-covers without apical membrane, but occasionally this, as well as the wings, is fully developed. [The ocelli are wanting in this species, which forms the type of the genus *Pyrrhocoris*, Fall.; *Platynotus*, Schill.; or *Astemma* of Lep. and Serv. It is occasionally found in this country.]

The species with the fore-legs thickened form the genus *Pachymerus*, Lep. and Serv., but which name having been previously used, must be changed. [The species are very numerous, and form Hahn's genus *Rhyparochronus*.]

[*Geocoris*, Fallen, *Opthalmicus*, Schill.] *Salda*, Fab., has the head as broad as the thorax, and often dilated behind, with large eyes, *S. atra, grylloides*, &c., Fabr.

Myodatha, Latr., has the hind part of the head elongated into a neck.

We now arrive at those *Geocorisæ longilabres* with four-jointed antennæ, slender, and often capillary at the tips.

Astemma, Latr. has the second joint of the antennæ of equal thickness, the thorax scarcely broader behind than in front, transverse, quadrate, or cylindrical. *Salda pallicornis*, &c.

Miris, Fab., resembles Astemma in the antennæ, but has the thorax narrowed in front.

Capsus, Fab., has the thorax trapezoid, and the second joint of the antennæ slender at the base, pilose and thick at the tip. [*C. ater*, and a great number of English species.]

* The Rev. F. W. Hope has published a catalogue of the species belonging to this tribe, with the description of a great number of new species Germar has also added many new genera and species in the first part of his *Zeitschrift fur die Entomologie*, 1839.

Heterotoma, Latr., has the two basal joints of the antennæ very thick and setose. The type of this curious genus is *Capsus spissicornis*, Fab. [a common British species].

The other Hemiptera of this family have only two or three joints in the sheath of the proboscis; the labrum is short, and not striated; the basal and often the second joint of the tarsi are very short; the legs inserted in the middle of the breast; the ungues apical. Some of these have the proboscis straight, and generally resting in a canal; the eyes of ordinary size, and the head not narrowed into a neck. The body is generally entirely or partly membranous, and often flattened. They compose the majority of the Fabrician genus *Acanthia*, from which the following have been separated.

Syrtis, Fab. (*Macrocephalus*, Swed., *Phymata*, Latr.), has the fore-legs very large and claw-like, serving to seize their prey. In Macrocephalus the scutellum is distinct, and covers nearly the whole abdomen. In Phymata (*S. crassipes*, F.), the [scutellum is minute], and only covers part of the upper side of the abdomen.

Tingis, Fab., has the body very flat, and the antennæ terminated by a short knob, the third joint being elongated; the majority live upon plants, puncturing the leaves of flowers, and sometimes producing galls. The leaves of the pear are often gnawed by *T. pyri*. [These are minute insects, many of which are English, having the body membranous, and covered with small cells; the thorax is extended behind, over the scutellum.]

Aradus, Fab., resembles Tingis in the form of the body, but has the antennæ cylindrical, with the second joint as long as the third, or longer. They are found under the bark of trees, in crevices of old wood, &c. [Small insects, of which several are found in this country. *A. depressus*, *Betulæ*, &c.]

Cimex proper, *Acanthia*, Fab., has the body very flat, but the antennæ terminate in a setaceous joint. The typical species, *C. lectularius*, Linn., the Bed-bug, is too well known to need description. It is said not to have existed in England before the great fire in 1666, and that it was imported in wood from America; Dioscorides, however, mentioned it. It has also been asserted that this species sometimes gains wings. It also infests young Pigeons, Swallows, &c.; but that which attacks the latter birds appears to me to form a distinct species. [The Rev. L. Jenyns has recently described it as distinct, *C. Hirundinis*; as well as one from Pigeons, *C. columbarius*; and one found on a Bat, *C. Pipistrelli*. (*Annals of Nat. Hist.*, June, 1839.)]

Fig. 96.—Cimex lectularius.

Various plans have been proposed for their extirpation, but the best is extreme cleanliness.

The other Geocorisæ of this subdivision have the proboscis exposed, arched, or sometimes straight, with the labrum prominent and the head suddenly narrowed behind into a neck. The latter form the primitive genus

REDUVIUS, Fabricius,—

In which the proboscis is short, very acute, and capable of pricking strongly, the pain of which lasts for a long time. The antennæ are very slender at the tips; many species produce a noise similar to that made by Crioceris and the Capricorn Beetles, which is more quickly repeated. This genus has been thus subdivided.

Holoptilus, Lep. and Serv., which have only three joints to the antennæ, the last two furnished with very long hairs, arranged in two rows, and verticillated in the last joint.

Reduvius proper, has the antennæ 4-jointed, and smooth, or but slightly pubescent, and the body is oblong-oval, with the feet of moderate size. *R. personatus*, Linn., inhabits the interior of houses, where it lives upon flies and other insects, which it approaches stealthily, and then darts itself, immediately killing them by piercing them with its proboscis. In the preparatory states it looks like a Spider, covering itself with particles of dust and dirt.

Nabis, Latr., in which the thorax is but slightly divided transversely, and *Petalocheirus*, Pal. Beauv., in which the fore tibiæ form a round plate, may be united therewith.

Zelus, Fab., has the body linear, with the legs very long, slender, and alike, [consisting of a great number of exotic species].

Ploiaria, Scop., differs from the last in having the two fore-legs [short] with elongated coxæ, formed as in Mantis for seizing the prey. *Gerris vagabundus*, Fabr. [an insect of small size, not uncommon in England].

We are now arrived at Geocorisæ remarkable for the large size of the eyes, and the head not formed into a neck, with the head transverse. They live at the sides of water, where they run with great agility, and often take short leaps.

Leptopus, Latr., has the proboscis short and arched, and the antennæ setaceous; [small species, several of which are found on the Continent].

Acanthia, Latr. (*Salda* proper, Fabr.), has the proboscis long and straight, and the antennæ filiform. *Salda litoralis*, Fabr., &c. [several British species of small size].

Pelogonus, Latr., differs from Acanthia in having the antennæ very short, and folded beneath the eyes. The species are small, and approach Naucoris, to which they conduct with the following.

Sometimes the four hind legs, very long and slender, are inserted upon the sides of the breast, and wide apart; the tarsal ungues are very small, indistinct, and fixed in a fissure at the side of the tarsi. These feet serve either for rowing or creeping on the water. They are peculiar to the genus

HYDROMETRA, Fabr.,—

Which Latreille divides into three others.

Hydrometra proper, with setaceous antennæ, and the head produced into a muzzle, with the rostrum received in a canal on the under side. [*H. stagnorum*, a small, very slender, and common species, found crawling on the surface of water.]

Gerris, Latr., has filiform antennæ, with the sheath of the proboscis 3-jointed, and the second pair of legs wide

apart from the anterior, and twice as long as the body. [Common insects, often seen skimming along the surface of the water.]

Velia, Latr., with the antennæ also filiform, but with the sheath of the sucker only 2-jointed; the legs moderately long, and placed at equal distances apart. *V. currens*, [a common British insect, seen running on the surface of brooks.]

[The works of Laporte Comte de Castelnau, the *Encyclopédie Méthodique*, Burmeister's *Manual of Entomology*, vol. ii., Spinola's *Essay on the Heteropterous Hemiptera*, and Hahn's work, *Die Wanzenartigen Insecten*, must be consulted for many new genera established in this division of the order.]

THE SECOND FAMILY OF THE HEMIPTERA,—

THE HYDROCORISÆ, or Water-bugs,—

Has the antennæ inserted beneath the eyes, by which they are concealed, being shorter than the head, or scarcely longer than it.

All these Hemiptera are aquatic and carnivorous, seizing other insects with their fore-legs, which fold upon themselves, and serve them as claws. They prick very sharply [with the proboscis]. The tarsi have only one or two joints; the eyes are generally of a remarkable size.

Some of the Hydrocorisæ, forming the subfamily *Nepides*, have the two fore-legs formed into claws composed of a very thick or very long thigh, channelled on the under side to receive the under surface of the tibia and of the tarsus, which is very short, or is united with the tibia, forming with it a strong hook; the body is oval and very depressed in some, and of a linear form in others. These insects form the genus

NEPA, Linn.,—

Which may be thus divided:—

Galgulus, Latr., in which all the tarsi are alike cylindrical, with two distinct joints, the last of which is furnished with two hooks at the tip; the antennæ appear to have only three joints, the last of which is large and ovoid. (*Naucoris oculata*, Fab.; North America.)

The antennæ in the following genera are composed of four joints, and the anterior tarsi are terminated simply in a point, or by a hook.

Naucoris, Geoff., has the labrum exposed, large, and triangular; the body is nearly oval and subdepressed; the eyes flattened; the extremity of the body is not furnished with elongated processes; the four hind feet are ciliated with 2-jointed tarsi, and two ungues at the tip. *N. cimicoides*, Linn., [a common British insect, half an inch long].

In the three following subgenera, the labrum is hidden in the canal, and the extremity of the abdomen furnished with two filaments.

Belostoma, Latr., has all the tarsi 2-jointed, and the antennæ semi-pectinated. [Exotic species.]

Nepa, Latr., has the fore tarsi formed of a single joint, and the four hind tarsi 2-jointed; the antennæ appear forked; the fore coxæ are long, and the thighs thicker than the other parts. The abdomen is terminated by two long filaments, which are employed in respiration; the eggs resemble the seed of some plant, being oval, surmounted by a coronet of hairs. M. L. Dufour has published an elaborate memoir on their internal anatomy. *N. cinerea*, Linn., of a dirty ash-colour, with the upper surface of the abdomen bright red, [is a very common insect.]

Fig. 97.—Nepa cinerea.

Ranatra, Fabr., differs from Nepa in its linear form, and the more elongated form of the legs. *N. linearis*, Linn. [a common British species in certain localities]. The coronet at the top of its eggs is formed of only two threads.

The others, *Notonectides*, have the two fore-legs simply incurved, with the thighs of the ordinary size; the tarsi diminishing to a point, and very much ciliated or similar to the others; the body is nearly cylindric or ovoid, and rather thick, or not so much depressed as in the preceding; the hind legs are very much ciliated, in the form of oars, and terminated by two very minute claws: they swim or row with great quickness, and often on their backs, [whence their generic name]. They compose the genus

NOTONECTA, Linn.,—

Which may be thus divided:—

Corixa, Geoff., which has no scutellum, the elytra horizontal; the fore-legs very short, with the tarsi composed of a single compressed and ciliated joint; the other legs are elongate, and the two middle ones terminated by two very long ungues. *N. striata*, Linn. [and several other small British species].

Fig. 98.—N. glauca.

Sigara, Leach, founded upon *N. minutissima*, Fabr., has the fore-tarsi 1-jointed, but possesses a distinct scutellum, and the body ovoid.

Notonecta, Linn., has a distinct scutellum; a rostrum elongate-conic; the wing-covers deflexed at the sides, and all the tarsi 2-jointed; the fore tarsi are cylindric, simple, and terminated by two ungues.

N. glauca, Linn., more than half an inch long, [is one of our commonest water insects]: it swims upon its back in order the better to seize its prey, and is able to prick sharply.

Plea, Leach, is founded upon *Notonecta minutissima*, Linn., which has the ungues of the hind feet large, and the elytra entirely crustaceous.

The second section of the Hemiptera, that of the

HOMOPTERA, Latr.,—

Is distinguished from the preceding by the following characters:—The proboscis arises from the lowest part of the head, near the breast, or even, as it appears, between the two fore-feet. The wing-covers (nearly always roof-like) are throughout of the same consistence and semi-membranous, sometimes even nearly like the wings. The three segments of the thorax are united into a mass, and the first is often shorter than the following. All the Hemiptera of this section feed only upon the fluids of vegetables; the females have a scaly ovipositor, generally composed of three denticulated plates, and lodged in a scabbard of two valves: they use this instrument as a saw to make notches in vegetables, in order to deposit their eggs. The terminal insects of this section undergo a kind of complete metamorphosis.

I divide it into three families, [*Cicadariæ*, *Aphidii*, and *Gallinsecta*.]

THE FIRST FAMILY OF THE HOMOPTEROUS HEMIPTERA,—

THE CICADARIÆ,—

Comprises those which have three joints in the tarsi, and the antennæ generally very small, conic, or awl-shaped, from 3- to 6-jointed, including a very slender seta, with which they are terminated. The females are provided with a denticulated, saw-like ovipositor. Messrs. Ramdohr, Marcel de Serres, Léon Dufour, and Strauss, have studied the anatomy of different insects of this family with great care; the latter has not yet however published his researches. Amongst the others, M. Léon Dufour is the author whose investigations are the most extended and complete, at least as regards the digestive and generative systems, as is easily proved on referring to his memoir intitled *Recherches anatomiques sur les Cigales*, inserted in the fifth volume of the *Annales des Sciences naturelles*.

Some of the Cicadariæ are named *Chanteuses*, and have the antennæ composed of six joints and three ocelli. The mesothorax, seen from above, is much more spacious than the prothorax, and is narrowed towards its extremity, where it forms a kind of scutellum. It is nearly of the same form in the Fulgoræ and other genera separated therefrom. The mesothorax is often of a reversed triangular form, and the prothorax is generally very short and transverse. In Membracis, Cicadella, &c., it is, on the contrary, much more extensive than the other thoracic segments, and very much developed in one or the other direction, and the mesothorax appears only in the form of an ordinary triangular scutellum. In the whole of the family, the mesothorax is very short and concealed. Considered in respect to other insects, the head of the Cicadariæ, seen in front, exhibits immediately above the labrum a triangular space, answering to the epistome or clypeus, above which is another space, often swollen and striated; above this is the forehead, and which is succeeded by the vertex or superior part of the head.

The Chanteuses comprise the *Cicadæ manniferæ*, Linn., or the genus *Tettigonia*, Fabr., and form with me the genus

CICADA, Oliv. (*Tettigonia*, Fabr.).

These insects, in which the wing-covers are almost always transparent and veined, differ from the following not only in the structure of their antennæ, and the number of the ocelli, but also in not possessing the power of leaping; the males also produce in the hottest part of the day a kind of monotonous and noisy music, whence they have been termed by authors "chanteuses," or singers. The organs of sound are placed at each side of the base of the abdomen, internal, and covered by a cartilaginous plate like a shutter, and which is an appendage of the under side of the metathorax. The cavity which incloses these instruments is divided into two partitions by a scaly and triangular edge; seen from the under side of the body, each cell exhibits anteriorly a white and folded membrane, and in the hollow part, a stretched-out slender membrane, which Réaumur calls the mirror: if this part of the body be opened from above on each side, there is seen another folded membrane, which is moved by a very powerful muscle, composed of a great number of straight and parallel fibres extending from the scaly ridge; this membrane is the *timbale*. The muscles, by contracting and relaxing with quickness, act upon the timbales, stretching them out, or bringing them into their natural state, whereby the sounds are produced, and which, even after the death of the animal, may be repeated by moving the parts over each other in the manner they act whilst alive.

The Cicadæ are found upon trees, or shrubs, of which they suck the sap. The female pierces the small twigs of dead branches of trees as far as the pith with its ovipositor, lodged in a semi-tubular sheath formed of two valves, and composed of three scaly pieces of a narrow and elongated form, two of which are terminated like a file, in order to deposit their eggs therein, the number of which being great, the female makes a succession of slits, the place of which is indicated by so many elevations on the exterior. The young larvæ quit their birth-place, however, in order to descend into the ground, where they increase in size and become pupæ. Their fore-legs are short, the fore thighs being very strong, and armed with teeth, fitted for burrowing in the earth. The Greeks devoured the pupæ, which they called *Tettigometræ*, as well as the perfect insect. Before coupling the males were preferred, but afterwards the females were selected, being filled with eggs. The *Cicada Orni*, by puncturing the elm, causes it to discharge the saccharine purgative fluid which has been termed manna.

[The genus is very numerous, and the species are found in all the warmer regions of the globe, some being of large size. In England we, however, possess but a single species, which has been figured by Curtis under the name of *C. anglica*. It has only occurred in the New Forest, in Hampshire.]

The species which have a slit on the upper side of the abdomen, exposing the timbale, such as *C. hæmatodes*, &c., compose the genus *Tibicen* of my *Fam. Nat.* *C. orni*, Fab., may in this respect form another genus. [See the monographs of Germar.]

The other Cicadariæ (*Muettes*) have only three distinct joints to the antennæ, and two small ocelli. Their legs are in general fitted for leaping; neither of the sexes is furnished with organs for the production of sound.

The wing-covers are often coriaceous and opaque; many of the females envelope their eggs in a white cottony mass.

Some of these (*Fulgorellæ*) have the antennæ inserted immediately beneath the eyes, and the forehead is often prolonged into a muzzle, varying in figure according to the species. This is the distinguishing character of the genus

FULGORA, Linn.

The species in which the forehead is advanced, with two ocelli, and which have no appendage beneath the antennæ, are the true *Fulgoræ* of Fabricius. Such is *Fulgora laternaria*, Linn., a very large species, varied with yellow and red, with a large eye-like spot on each of the hind wings; the muzzle is very much dilated, and vesicular. According to some travellers, this insect is affirmed to emit a very strong light during the dusk. [It is an inhabitant of South America. The statement of its luminous properties, originating with Madame Merian, requires confirmation. The species of the true genus *Fulgora* are rather numerous, extraordinary in their forms and colours, and widely dispersed. I have published a monograph, with figures of many new species, in the last part of the *Linnæan Transactions*.]

Fig. 99.—Fulgora laternania.

The south of Europe possesses a small species belonging to the same genus, *F. europæa:* [belong to the subgenus *Dictyophara*, Burm.]

Other Cicadariæ, with the forehead advanced, but wanting ocelli, and having two slender appendages beneath each antenna, compose the genus *Otiocerus*, Kirby (*Cobax*, Germar). [Small American insects, monographed by Kirby.]

Those in which the head is not remarkably produced in front are formed by Fabricius into several genera, to which others subsequently established, [especially by Germar, Guérin, and Burmeister,] must be added.

Sometimes the antennæ are shorter than the head, inserted at a distance from the eyes, in some of which the two ocelli are distinct.

Lystra, Fab., similar, at first sight, to small Cicadæ. The body and wing covers are elongated, the second joint of the antennæ is nearly globular, and granular, as in the Fulgoræ.

Cixius, Latr., resembles Lystra, but the second joint of the antennæ is cylindric and entire. The genns *Achilus*, K. [founded upon an Australian species, *A. flammeus*, K.] scarcely differs from Cixius.

I have separated, under the generic name of *Tittigometra*, insects analogous to the preceding, but in which the antennæ are lodged between the posterior and lateral angles of the head and those of the anterior extremity of the thorax. The eyes are not prominent. [Small European insects.] *Cælidea*, Germar, appears to be closely allied to Tettigometra, of which they have the aspect, and are described as having the antennæ inserted beneath the eyes.

In the others the ocelli are wanting.

The species which have the wing-covers large, and the prothorax evidently shorter in the middle than the mesothorax, compose the subgenus *Pœciloptera*, Latr., *Flata*, Fabr.

Issus, Fab., is composed of those species in which the prothorax is at least as long as the mesothorax, and the wing-covers, shorter, or as long as the abdomen, are dilated at the base, and subsequently narrowed.

In others, the antennæ are at least as long as the head, and often inserted in a notch below the eyes.

Anotia, Kirby, allied to Otiocerus, and which approaches the preceding in the mode of insertion of the antennæ. [Small exotic insects.]

Asiraca, Latr. (*Delphax*, Fab.), has the antennæ inserted in a notch below the eyes, as long as the head and thorax, with the first joint generally longer than the second, compressed, and angulated; the ocelli are wanting. [*A. clavicornis*, Latr., a small, exceedingly active species, and several others, inhabitants of this country.]

Delphax, Fab., has the antennæ similarly inserted, but not longer than the head, with the first joint much shorter than the second; the ocelli are present. [Numerous very small species, found by sweeping grass at the sides of roads, commons, &c. Some of the species occasionally have the wing-covers only partially developed. These constitute the genus *Criomorphus*, Curtis.]

Derbe, Fabr., are unknown to me, but I presume they come near the preceding insects, and especially to Anotia.

In the terminal Cicadariæ the antennæ are inserted between the eyes. These compose the genus

CICADELLA (or the *Cicadæ Ranatræ*, Linn.),—

Which may be thus divided :—

We commence with the species which, with the exception of a small number, (*Ledra*,) formerly composed the genus *Membracis* of Fabricius. The head is very much deflexed, or low in front, and prolonged into an obtuse point under the form of a clypeus, more or less semicircular. The antennæ are always very small, terminated by an inarticulate seta, and inserted in a cavity under the margins of the head; the prothorax is sometimes dilated, and horned on each side, and prolonged behind into a simple or composite horn, and sometimes it is elevated longitudinally down the back, compressed like a crest, sometimes porrected and pointed in front; the legs are seldom spined.

[This genus comprises three principal groups,—the *Membracides*, *Cercopides*, and *Cicadellinæ*].

Some [the *Membracides*] have no scutellum, properly so called, exposed.

Membracis, Fab. (having the prothorax elevated, compressed, and leaf-like along the middle of the back), and

Tragopa, Latr. (where this part of the body is horned, or pointed on each side, without any intermediate elevation, and posteriorly produced into a point as long as the abdomen), have the tibiæ, especially of the fore-feet, foliaceous.

In the following the tibiæ are of the ordinary form, and not foliaceous.

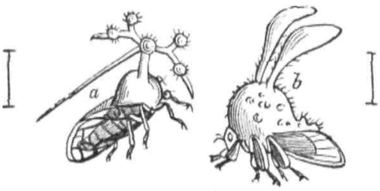

Fig 100.—*a*, Bocydium globulare, *b*, B. cruciatum.

Darnis, Fabr., in which the prolongation of the prothorax is in the shape of a long triangle, covering the wings and abdomen.

Bocydium, Latr., has the prolonged part narrowed so as to expose the wings and sides of the abdomen, and more or less lanceolate, or spear-shaped. [Such are *Bocyd. globulare*, and *B. cruciatum*, two extraordinary Brazilian insects, of small size, here figured. The majority of the species of Membracides are exotic, of small or but moderate size, and amongst them are to be found some of the most anomalous forms.]

In others the scutellum, although the prothorax is prolonged, is exposed, at least in part, the posterior extremity of the prothorax exhibiting a transverse suture, which distinguishes it from the scutellum. These form the subgenus *Centrotus* proper. Types, *C. cornuta* and *C. genistæ*. [Two small species, of rather common occurrence in woods in this country, the last of which is figured in the *Entomologist's Text Book*, pl. 3. f. 2.]

We now pass to the species in which the head is but little lower than, or on the same plane as, the prothorax; horizontal, or but little deflexed when seen from above, and in which the prothorax is neither elevated in the middle, nor posteriorly prolonged, offering only lateral dilatations, and in which the mesothorax assumes the form of a triangular scutellum, of the ordinary size; the wing-covers are always exposed; the posterior tibiæ are more or less spined.

In many, such as the following [which compose the tribe *Cercopides*], the thorax has the form of an irregular hexagon, being prolonged and narrowed behind, and terminated by a truncature fitting to the base of the scutellum, and often receiving it; this truncature being concave, or emarginate.

Ætalion, Latr., has the crown of the head transverse, the forehead being suddenly deflexed in front, and the antennæ are inserted above a line drawn between the eyes. [Brazilian insects.]

In the three following subgenera the vertex is triangular and bears the ocelli, and the antennæ are inserted in a line drawn between the eyes.

Ledra, Fab., has the head very flat between the eyes, like a transverse clypeus; the sides of the prothorax are

dilated into short wing-like appendages, and the hind tibiæ are very compressed, and margined by a membrane. *C. aurita*, Linn., [a species not uncommon in the woods in Kent].

Ciccus, Latr., has the antennæ terminated suddenly after the second joint in a seta composed of four distinct cylindric and elongated joints; the anterior extremity of the head is generally advanced. [Exotic species.]

Messrs. Serville and Saint Fargeau [as well as Drs. Germar and Burmeister] have established numerous additional genera in this group. The *Eurymela fenestrata*, Serv. and St. F., described by them as Brazilian, is a native of New South Wales, the description given of which by these authors being inexact, the insect possessing ocelli, although difficult to be detected. Hence this genus ought to be introduced at the genus *Issus*.

Cercopis, Fab., Germ. (*Aphrophora*, Germ.), has the third joint of the antennæ conical, and terminated by an articulated seta.

[*C. vulnerata*, Rossi, the only British species closely allied to *C. sanguinolenta*, Linn., is a common insect, and the handsomest in the family; being black, with blood-red spots.] *C.* [*Aphrophora*] *spumaria*, Linn., is an extremely abundant species, the larva of which is found upon leaves and twigs in the midst of a frothy secretion, of a white colour, which has been commonly called Cuckoo-spit.

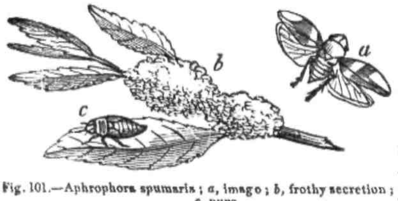

Fig. 101.—Aphrophora spumaria; *a*, imago; *b*, frothy secretion; *c*, pupa.

In the other Cicadariæ, terminating this family, [and forming the tribe *Cicadellines*, and which in the earlier works of Fabricius formed his genus *Cicada*], the prothorax is not at all, or scarcely, prolonged posteriorly, and is terminated by a straight, or nearly straight, line, as long as the breadth of the body, the scutellum, at its base, occupying a great portion of this breadth.

Eulopa, Fallen, has the eyes very prominent, the head but little advanced beyond the eyes, but depressed, and forming a kind of ridge round the face; two ocelli placed on the posterior and superior part of the head, and legs destitute of spines or teeth. *C. Ericæ*, a small species, [found on heaths].

Eupelix, Germar, has the head in the form of an elongated and very flat triangle, with the ocelli situated in front of the eyes, upon the edges of the head, which are prolonged, nearly cutting through the eyes. *C. cuspidata*, Fab. [a rare British species, found with the preceding].

Penthimia, Germ., has the antennæ inserted in a large channel, reducing the space between the eyes more than ordinary; the head, seen from above, appears semicircular, and gradually deflexed in front; it is rounded, and its edges are extended above these channels; the body is short. These insects have some resemblance to Cercopis, with which Fabricius united them. *C. sanguinicollis*, Fabr., [a very rare British species].

Gypona, Germar, appears to be closely allied to Penthimia, but I have seen no specimen of that subgenus.

Iassus, Fabr., has the superior surface of the head comprised between the eyes, very short, transverse, and linear, or arched, and very little advanced even in the middle beyond the eyes. The plates at the sides of the clypeus are large; the antennæ terminate in a long seta; the ocelli are situated near or below the anterior margin of the head. [Numerous small British species, divided by Curtis, Lewis, Burmeister, and Germar into various subgenera.]

Cicadella proper, or *Tettigonia*, Fabr., Oliv.; *Cicada*, Linn., has the head, seen above, triangular, without being either very long or very flat, whereby it is distinguished from Eupelix; the eyes also are not cut into by the sides of the head; the ocelli are situated between them. These insects are, in other respects, very nearly related to Iassus, as well as in respect to the extent of the plates at the sides of the face, and the length of the seta of the antennæ, which appears to be articulated at its base, as in Ciccus, from which it chiefly differs in the form of the thorax. [This is also a very numerous group, which has been likewise much cut up by late writers.] Some of the species, as *C. grisea, transversa, striata*, Fabr., appeared to Latreille to form a distinct subgenus, from the flattened form of the head, and the ocelli inserted near its edge.

THE SECOND FAMILY OF THE HOMOPTEROUS HEMIPTERA,—

THE APHIDII, commonly called Plant Lice,—

Which are distinguished from the preceding by having only two joints in the tarsi, and the antennæ filiform, or like a thread, and longer than the head, composed of from six to eleven joints.

The winged individuals have always two wing-covers and two wings. These are very small insects having the body generally soft, and the wing-covers very similar to wings, differing only in being larger and somewhat thicker. They multiply with exceeding rapidity.

Some have ten or eleven joints in the antennæ, the last of which is terminated by two setæ. They leap well, and form the genus

PSYLLA, Geoff. (*Chermes*, Linn.).

These Hemiptera, which are also termed by the French False Plant-lice, live upon trees and plants,

from which they obtain their nourishment; the two sexes are winged; the larvæ have the body generally very flat; the head broad, and the abdomen rounded behind. Their legs are terminated by a membranous vesicle, accompanied beneath by two ungues. Four broad pieces, which are the sheaths of the wing-covers and wings, distinguish the pupæ: many in this state, as in that of the larva, are covered by a white cottony secretion, arranged in flakes. Their excrements form threads or masses, of a gummy saccharine nature.

Some species, by puncturing vegetables to extract the sap, produce in various parts, especially in the flowers and buds, monstrosities, having the appearance of galls. In this number is *Psylla Buxi*, figured by Réaumur, *Mem. Ins.*, vol. iii. pl. 19, fig. 1—14, which is found on the box. The alder, fig, nettle, &c. produce other species.

Latreille has formed with the species which lives in the flowers of *Juncus articulatus*, a genus, under the name of *Livia*. The antennæ are much thickened at the base.

[Mr. Curtis has published the figure of another genus under the name of *Livilla*, founded upon a small, interesting British species.]

The other Aphidii have only six or eight joints in the antennæ, the last of which is not terminated by two setæ.

Sometimes the wing-covers and wings are linear, fringed with hairs, and carried horizontally upon the body, which has nearly a cylindrical form; the proboscis being small, or scarcely distinct. The tarsi are terminated by a vesicular joint without ungues; and the antennæ have eight somewhat moniliform joints. Such is the genus

THRIPS, Linn.,—

The species of which are extremely active, and appear to leap rather than fly. When much irritated, they elevate and bend the extremity of their bodies into an arch in the same manner as the Staphylini. They live upon flowers and plants, and under the bark of trees. The largest species scarcely exceed a line in length.

F. 102.—Thrips.

Latreille observes in a note that the structure of the mouth exhibited to him characters which appeared essentially to distinguish the species of Thrips from the other insects of this order. M. Strauss also, who had studied them with admirable precision, considered that they belonged to the order Orthoptera. [Subsequently, the genus has been raised to the rank of a distinct order by Mr. Haliday in a valuable memoir published in the *Entomological Magazine*, under the name of *Thysanoptera*, and I have illustrated the structure of the mouth in my *Modern Classification of Insects*, vol. ii. p. 1, with figures. Mr. Haliday has established a number of generic and subgeneric divisions.]

Sometimes the wing-covers and wings are oval or triangular, without a fringe of hairs, and are deflexed at the sides like a roof; the rostrum is very distinct; the tarsi are terminated by two ungues; and the antennæ have only six or seven joints: these form the genus

APHIS, Linn.

Aphis, proper, has the antennæ longer than the thorax, 7-jointed, the third being elongated; the eyes are entire, and the posterior extremity of the abdomen is furnished with two horns or tubercles.

They live mostly in society upon trees and plants, which they suck with their proboscis. They do not leap, and crawl but slowly. The two horns at the extremity of the body in many species are tubes, from which frequently exude small drops of a transparent saccharine fluid, [termed honey-dew], of which the ants are very fond. Each society consists in spring and summer of plant-lice always apterous, and of pupæ [demi-nymphes], of which the wings ought to be developed; all these individuals are females, which produce living young, which are ejected tail foremost, without any previous coupling. The males, amongst which some are winged and some wingless, appear only at the end of the summer or in autumn. They fecundate the last generation produced from the preceding individuals, consisting of wingless females which require impregnation, after which they deposit eggs upon the branches of trees, which remain in that state all through the winter, from which young plant-lice are produced in the spring, capable of multiplying without union with the males.

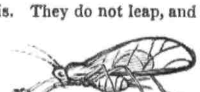
Fig. 103.—Aphis Rosæ.

The influence of a single impregnation thus extends through several successive generations. Bonnet, to whom we are indebted for the majority of the facts observed upon this subject, obtained, by the isolation of females, nine generations in the space of three months. The punctures which the plant-lice make in the leaves and young twigs of vegetables, often cause these parts to assume different forms, as may be seen in the young buds of the lime, the leaves of the gooseberry, pear, and especially of the elm, poplar, &c., where they produce a kind of vesicles or excrescences, containing whole families of plant-lice, and often a saccharine fluid, in the interior. The

majority of these insects are covered with a mealy matter, or with cottony threads, sometimes arranged in rows. The larvæ of the Hemerobii, those of many Diptera, and Coccinellæ, destroy a great number of plant-lice. M. Aug. Duvau has communicated to the Academy of Sciences the interesting result of his observations on these insects, and his memoir has been inserted in the collection of those of the *Muséum d'Hist. Nat.*

The Aphis of the oak (*A. Quercûs*, Linn , Réaumur, 3, pl. 28, f. 5), is remarkable for having the proboscis at least three times as long as the entire body.

M. Blot has published, in the *Memoirs of the Linnæan Society of Caen*, 1824, various curious observations upon a species found in the Departement du Calvados, which is very injurious to the apples, destroying the young shoots. He considers it as the type of a new genus, which he calls *Myzoxyle*. [It is probable that this insect is identical with that so well known in England under the name of *Apple-blight*, which is covered entirely with a white cottony secretion, and which multiplies in vast numbers in the crevices of the bark of diseased apple-trees.] De Geer also described a species of Aphis found upon the apple, but which differs materially from that described by M. Blot, which last has no horns on the abdomen, the antennæ are shorter, and, according to M. Blot, only 5-jointed, the second joint being the longest. [The species of this family, Aphidæ, are extremely numerous, almost every plant possessing a distinct species. They however require a more minute investigation than has yet been given to them. The Senator Van Heyden has described several new genera recently in the *Memoirs of the Museum Seckenbergeanum*.]

Aleyrodes, Latr. (*Tinea*, Linn.), has the antennæ short, 6-jointed, and the eyes notched. Type, *T. proletella*, Linn.; Réaumur, *Mémoires*, vol. ii. pl. 25, fig. 1—7, resembles a small white moth, having a small blackish spot on each wing-cover. It is found on the leaves of the Chelidonium, cabbage, oak, &c. Its larva is oval, very flattened, like a minute scale, and resembles that of Psylla. The pupa is fixed, and inclosed in an envelope, so that this insect undergoes a complete metamorphosis.

THE THIRD FAMILY OF THE HOMOPTEROUS HEMIPTERA,—

THE GALLINSECTA,—

Of which De Geer formed a distinct order, have only a single joint* in the tarsi, with a single hook at the tip. The male is destitute of a proboscis, has only two wings, which shut horizontally upon the body; the abdomen is terminated by two threads. The female is without wings, and furnished with a proboscis. The antennæ are filiform, or thread-like, and often eleven-jointed (nine in the species described by Dalman in the memoir noticed below). These insects compose the genus

Fig. 104.—Coccus aceris, male & female.

COCCUS, Linn. (or Scale-insects).

The bark of many of our trees appears often warty, by reason of a great number of small oval or rounded bodies, like a shield or a scale, which are fixed to them, and in which no external traces of the insect are to be observed. They nevertheless belong to this class of animals, and to the genus *Coccus*. Some of these are females; the others are young males, and which are similar to them in form. But a period arrives when all these individuals undergo singular changes. They fix themselves to the plant, the larvæ of the males for a determinate period necessary for their transformations, and the females permanently. If observed in spring, their bodies are noticed gradually to increase in size, ending in their acquiring the appearance of a gall, being either spherical, kidney-shaped, boat-shaped, &c. The skin in some is entire and very smooth; in others it is incised, or offers traces of segments. It is in this state that the females are impregnated, shortly after which they deposit their eggs, of which the number is very great; these they deposit between the ventral surface of their bodies and a layer of a cottony secretion, with which they had previously lined the spot on which they had stationed themselves. Their bodies subsequently dry up and become a solid cocoon, which covers the eggs. Other females envelope their eggs in a very abundant cottony secretion, which equally defends them. Those which are of a spherical form become a kind of box, inclosing the eggs. The young Scale-insects have the body oval, very flat, and furnished with the same organs as their mother. They disperse themselves over the leaves, and reach by the end of the autumn the branches, on which they affix themselves in order to pass the winter. Some, the females, prepare at the commencement of summer to become parents; and the others, or the larvæ of the males, are transformed into pupæ beneath their own skin. These pupæ have the two fore-feet directed forwards, and not backwards, like the four hind legs, and like all the legs of the other inactive pupæ. Having acquired

* Dalman, in a memoir upon some species of Coccus, considers that the number of the joints in the tarsi is three.

wings, the males make their escape from the posterior extremity of their cocoons backwards, and then seek the females, which are much larger than them. Réaumur observed two small points like ocelli at that part of the head which corresponds with the mouth. I have discovered in the head of the male of the Coccus of the elm ten small similar points, as well as two balancers on the sides of the thorax. Geoffroy states that the females have at the extremity of the body four white filaments, which appear only on pressing the body of the insect.

Dorthez observed upon the *Euphorbia Characias* a species which appears to differ in several respects both of structure and habits from the other species, and which determined M. Bosc to form this insect into a distinct genus, named *Dorthesia*. The antennæ have nine joints, much longer and slenderer in the male than in the female; the latter continues to live and to be active for some time after depositing her eggs; the male has the extremity of the body furnished with a thick brush of long white threads: hence this insect is nearer allied to the Aphides than to the Cocci.

The Cocci appear to injure the trees, by causing by their punctures a too abundant overflowing of the sap. Hence they require the attention of those persons who cultivate peaches, oranges, figs, and olives. Some species attack the roots of plants; some are precious on account of the splendid scarlet colour they furnish for the dyer. Further researches on these insects might detect others equally useful in this respect.

Geoffroy divided these insects, which are called by the French *Galle insectes*, or, by contraction, *Gallinsectes*, into two genera, *Chermes* and *Coccus;* the latter was called by Réaumur, *Progall-insecte*.

The Mealy-bug, *C. adonidum*, is somewhat of a rosy hue, with the body covered with a white mealy powder; the wings and anal setæ of the male are of the latter colour. The female has the sides of the body furnished with appendages, of which the two posterior are longer, and form a kind of tail. The female envelopes its eggs in a white cottony secretion, which serves them as a nest. It is naturalised in our hothouses, where it does much mischief.

The female of *Coccus Cacti* [the Cochineal insect of commerce], is of a dark brown colour, covered with a white down, flat beneath, convex above, margined, with the segments rather distinct, but becoming obliterated at the period of oviposition. The male is of a dark red, with white wings. It is cultivated in Mexico upon a species of Cactus or Opuntia, and is distinguished by the name of *Mestcque*, or fine cochineal, from another closely allied species, smaller and more cottony, called the wild cochineal. It is celebrated for the crimson dye that it produces; it also furnishes carmine. This production is one of the chief riches of Mexico.

Coccus polonicus [or the Scarlet Grain of Poland], was also employed in Poland as a considerable object of commerce, before the introduction of the Coccus Cacti as a dye. It lives upon the roots of *Scleranthus perennis*, and some other plants. The colour produced from this species is almost equal to that of the Coccus Cacti.

Coccus Ilicis, Linn., which lives upon a small kind of oak in the south of Europe, and of which the female reaches the size of a pea, was employed before the introduction of cochineal. It is also still employed in medicine.

A species from the East Indies produces gum lac, and another is employed in China for the manufacture of wax tapers.

A male Coccus, from Java, remarkable for having the antennæ composed of about 22 joints, moniliform, and very pilose, having two thick and nearly coriaceous wings, composes the genus *Monophleba* of Leach.

[These insects have recently been divided into several other genera by Illiger, Bouché, Burmeister, &c.]

THE EIGHTH ORDER OF INSECTS,—

THE NEUROPTERA (ODONATA, and the major part of SYNISTATA, Fabr.),—

Is distinguished from the preceding orders by the fore-wings being membranous, generally naked, transparent, and similar to the two posterior in respect to their consistence and uses; from the 10th and following, by the number of these organs as well as by the structure of the mouth, which is fitted for mastication, or furnished with true mandibles and maxillæ, that is, formed on the ordinary plan [for biting], a character which separates this order from the tenth, or that of the Lepidoptera, of which the fore-wings are, moreover, mealy. In the Neuroptera these wings have their surface furnished with a very fine net-work; the inferior being mostly as large as the superior, or sometimes larger, sometimes narrower, but longer. The maxillæ and the inferior piece of the lower lip, or the mentum, has never a tubular

formation; the abdomen is not furnished with a sting, and is but seldom provided with an ovipositor.

They have for the most part the antennæ like a thread, and composed of a great number of joints; two or three ocelli; the thorax is formed of the three segments intimately soldered into one mass, distinct from the abdomen, and supporting the six feet; the first of these segments is generally very short, and like a collar. The number of the joints in the tarsi is variable; the body is generally elongate, with the integuments soft, or but slightly scaly; the abdomen is always sessile. Many of these insects are carnivorous in their first and last states.

Some undergo only a demi-metamorphosis, the others are subject to a complete one; but the larvæ have constantly six feet with hooks, of which they commonly make use in searching after their food.

I divide this order into three families, which, in their progressive arrangement, exhibit the following natural relations:—1st. Carnivorous insects undergoing a demi-metamorphosis, with aquatic larvæ. 2nd. Carnivorous insects undergoing a complete metamorphosis, with terrestrial or aquatic larvæ. 3rd. Carnivorous, or omnivorous and terrestrial insects, undergoing a demi-metamorphosis. 4th. Herbivorous insects undergoing a complete metamorphosis, with aquatic larvæ, constructing for themselves portable cases. We finish with such as have the wings less net-like, and which resemble Phalænæ, or Moths.

THE FIRST FAMILY OF THE NEUROPTERA,—

THE SUBULICONES, Latr.,—

Is composed of the order *Odonata* of Fabricius, and of his genus *Ephemera*. The antennæ are in the form of an awl, scarcely longer than the head, 7-jointed at the most, the last being in the form of a seta. The mandibles and maxillæ are entirely covered by the labrum and labium, or by the anterior and advanced extremity of the head. The wings are always very much reticulated, extended sometimes horizontally and sometimes elevated perpendicularly; the posterior are as large as the anterior, or sometimes smaller, and even obsolete. In all, the ordinary eyes are large and very prominent, and they have two or three ocelli situated between the preceding. They pass the first two stages of their existence in the water, where they feed upon living prey.

The larvæ and pupæ, of which the form approaches that of the perfect insect, respire by means of peculiar organs, situated upon the sides of the abdomen, or at its extremity. They creep out of the water in order to undergo their final transformation.

Some of them have the mandibles and maxillæ corneous, very strong, and covered by the two lips; the tarsi are 3-jointed; the wings of equal size, and the posterior extremity of the body terminated simply by hooks, or leaf-like appendages. They form the order *Odonata*, Fabricius; or the genus

LIBELLULA, Linnæus, [Dragon-flies or Adder-bolts].

The slender form of the body, their varied colours, their large gauze-like wings, the rapidity of flight with which they pursue other insects upon which they feed, easily distinguish these Neuropterous insects. They have a large and rounded head, or in the form of a broad triangle, two very large lateral eyes—(see M. Cuvier's memoir on their composition in the *Mem. de la Soc. d'Hist. Nat. de Paris*)—three ocelli, situated upon the vertex; two antennæ, inserted upon the forehead behind a vesicular elevation, and composed, in the greater number, of five or six joints, or three at least, of which the last is compound, and becomes gradually slender like a style; the upper lip is semicircular; the two mandibles scaly, very strong, and toothed; the maxillæ are terminated by a piece of the same consistence, toothed, spined, and ciliated on the inside with a palpus composed of a single joint applied upon it dorsally, resembling the galea of the Orthoptera; the under lip is large, and composed of three leaves; the lateral pair, being the labial palpi, greatly dilated; a kind of epiglottis, or elongated vesicular tongue, in the interior of the mouth; the thorax thick and rounded; the abdomen very long, and flattened or cylindric, terminated in the males by two lamellar appendages, of which the figure varies

according to the species, and which have been carefully studied by Messrs. Van der Linden and Charpentier; the legs short, and directed forwards.

The female, in order to deposit her eggs, places herself upon plants close to the edge of the water, into which she repeatedly thrusts the extremity of her body. The larvæ and pupæ reside in the water until the period of their final transformation, and are somewhat like the perfect insect, except in wanting wings. But the head, upon which we perceive no ocelli, is remarkable for the singular form of the piece which occupies the place of the lower lip. This is a kind of mask, covering the mandibles, maxillæ, and nearly all the under side of the head. It is composed, 1st, of a principal triangular piece, which Réaumur calls the *mentonnière*, and which articulates by a hinge with a peduncle attached to the head; 2nd, of two other pieces inserted at the lateral and anterior angles of the preceding piece, moveable at the base, transverse, and entire, in the form of broad and denticulated plates, similar, in their mode of closing the mouth, to a pair of shutters, or in the form of small hooks. The insect is able to close or extend this very quickly, seizing its prey by means of the claws at its upper part. The posterior part of the abdomen is sometimes furnished with five unequal-sized conical plates, capable of opening or closing, and forming a kind of pyramidal tail, and sometimes with three elongated villose plates like oars. These insects may be seen every instant opening the rectum in order to take in a supply of air, when they close it again, and shortly afterwards eject the water with force and mingled with bubbles of air, this action appearing to assist them in their motions. [Its more immediate object is, however, in order to obtain a supply of fresh oxygen from the water thus introduced into the rectum.] When arrived at the period for their final change the pupæ quit the water, crawl up some adjacent stem, where they fix themselves by their claws, and scale off their pupa-skin.

M. Poey, who has particularly studied the insects of Cuba, has informed me, that at a certain season of the year the northerly winds bring to the city of Havannah and its neighbourhood an innumerable quantity of specimens of one of the species of Libellulæ. [Other instances of their periodical flight or migrations in Europe have been observed. See Dr. Weissenborn's memoir on this subject in the new series of the *Mag. of Nat. Hist.*]

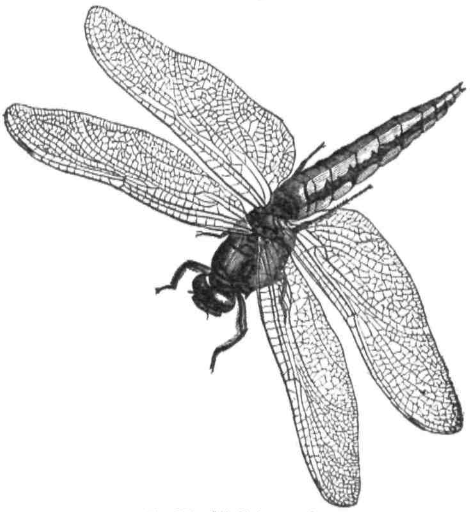
Fig. 105.—Libellula cancellata.

Fabricius, preceded in this respect by Réaumur, divided the Dragon-flies into three genera.

Libellula proper, has the wings extended horizontally in repose; the head nearly globular, with the eyes very large; a vesicular elevation, having on each side an ocellus, upon the vertex; the other ocellus, or the anterior one, is much larger, and the middle division of the lower lip much smaller, than the lateral ones, which, closing by a straight suture, exactly shut the mouth. The abdomen is generally broad and flat. The larvæ and pupæ have five appendages at the extremity of the body, which is short. Type, *L. depressa*, Linn., [a very common British species, as well as *L. cancellata*, here figured, the males in both of which are remarkable for the fine leaden-blue colour of their abdomen]. The memoir of Van der Linden on the Libellulæ of Bologna, and subsequently upon those of Europe, as well as the *Horæ Entomologicæ* of M. Charpentier, and a series of memoirs by M. Boyer de Fonscolombe in the *Annales de la Société Entomologique de France*, may be consulted. The British species, distributed into various genera, have been described by Mr. Stephens.]

Æshna, Fabr., is similar to Libellula in the manner in which the wings are carried when at rest, and in the form of the head, but in which the two posterior ocelli are situated upon a simple transverse elevation, having, moreover, the middle lobe of the lower lip larger, and the two others wide apart, and armed with a strong tooth or spine; the abdomen is always long, narrow, and cylindric. The body of the larvæ and pupæ is also more elongate than in those of Libellula; the mask is flat, with its two hooks narrow, and armed with a moveable hook at the tip. *Libellula grandis*, [a common English species, two inches and a half long, and many others]. They fly with astonishing rapidity over the margin of waters, pursuing flies and other insects in the same manner as swallows.

Agrion, Fabr., has the wings elevated perpendicularly in repose; the head transverse, with the eyes apart; the form of the lower lip is similar to that of Æshna, but its middle lobe is slit to the base. The forehead is not furnished with a vesicle; the ocelli are nearly equal in size, and arranged in a triangle on the vertex; the abdomen is very slender and filiform, and occasionally very long. The body in the larva and pupa states is also long and slender, and the abdomen terminated by two oar-like appendages; the mask is flat, with the superior extremity of the chin-piece elevated into a point in some, and forked in others. *Libellula virgo*, Linn., is of a golden-green or bluish-green colour, with the wings blue, either entirely or partially, and sometimes pale brownish-yellow. [This and several other species of smaller size, belonging to the subgenera separated from Agrion by Leach, are of very common occurrence in this country.]

The other SUBULICORN NEUROPTERA have the mouth entirely membranous or very soft, and composed of parts very indistinct; they have 5-jointed tarsi; the lower wings are much smaller than the superior, or even wanting; and the abdomen is terminated by two or three long threads. They form the genus

EPHEMERA, Linn.,—

Thus named from the short duration of their life in the perfect state. The body is soft, long, slender, and terminated behind by two or three long articulated filaments. The antennæ are very small, and composed of three joints, of which the last is very long, in the form of a conical thread. The front of the head is advanced like a hood, often keeled and notched, and covers the mouth, of which we cannot trace the organs on account of their softness and smallness. These insects carry their wings almost always elevated perpendicularly, or but slightly deflexed, like the Agrions. The legs are very slender, with the tibiæ very short and united to the tarsi, which have often only four joints, the first being nearly obsolete. The two ungues of the terminal joint are very compressed, and the fore-legs are much longer than the others.

The *Ephemeræ* generally appear at sunset in the fine days of summer and autumn, along rivers, lakes, &c., and sometimes in such numbers that the ground, after their death, is covered with them, so that they are carted away as manure. The falling of one species, with white wings, resembles that of a fall of snow.

These insects unite in swarms in the air, where they fly up and down, extending the threads of their tails. It is there also that the sexes unite, the males being distinguished by two hooks at the extremity of the body; their fore-legs and anal threads are also longer, their eyes larger, and some males possess four eyes, two being much larger, and elevated on columns. The females deposit their eggs in a gelatinous mass, and, as the propagation of the species is the only object of the existence of the individual, they very soon perish, often on the day in which they undergo the final change, sometimes living only a few hours. Those which fall on the water are greedily seized by the fishes, and fishermen give them the name of Manna. But if we consider them in the larva state, we find their existence extending through two or three years. In this, and the pupa state, they reside in the water, concealed during the day under stones, or in horizontal burrows, which they form in the banks, from which it is supposed that these larvæ derive their food. Although resembling the perfect insect in several respects, they differ materially in having longer antennæ, wanting ocelli; by possessing horn-like mandibles; the abdomen has, moreover, on each side, a row of plates, mostly in pairs, which are a kind of false branchiæ, and which are employed not only in respiration, but also as paddles. The pupa differs from the larva by possessing scales inclosing the wings. At the moment when they undergo this change they quit the water, and appear, after casting their skin, under a new form; but, by a singular exception, they have to undergo another moulting before they are fit for propagation. Their last exuviæ are often found fixed to trees, and upon walls.

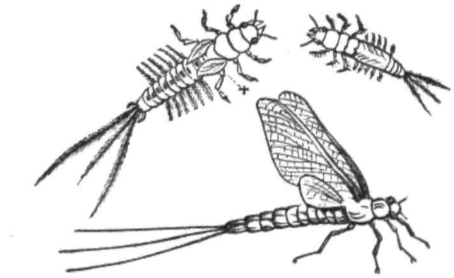

Fig. 106.—Ephemera vulgata: larva, pupa, and imago.

De Geer formed these insects and the *Phryganeæ* into a distinct order, in consequence of the minuteness or absence of the parts of the mouth. In the *Tableau Elementaire* of Cuvier they also form a peculiar group, named *Agnatha*, but which formed part of the order Neuroptera.

The number of the wings and of the anal filaments lead to the establishment of various divisions in the genus Ephemera; some having four wings and two tails (*E. Swammerdamiana*); others four wings and three tails (*Ephemera* proper, *E. vulgata*, Linn.); some with two wings and three tails, and the eyes of the male doubled, one pair placed in foot stalks. [Others again have only two wings and two tails. These various groups have been formed into separate genera by Leach, and other subsequent authors, *E. vulgata*, the commonest species, and which is well known to fly-fishers under the name of the Grey Drake, being retained as the type of the restricted genus Ephemera.]

THE SECOND FAMILY OF THE NEUROPTERA,—

THE PLANIPENNES,—

Which composes, with the following, the greater portion of the order *Synistata* of Fabricius, comprises those Neuroptera which have the antennæ always composed of a great number of joints, and longer than the head; the mandibles are distinct, and the lower wings nearly equal to the upper, extended, or simply folded under at the inner edge.

They have generally the wings very much reticulated and naked, with the maxillary palpi ordinarily filiform, or rather thickened at the tips, shorter than the head, and composed of four or five joints.

I shall divide this family into five sections, composing, on account of their habits, so many small distinct sub-families.

1. The *Panorpatæ* of Latreille, which have five joints in all the tarsi, and the anterior extremity of the head prolonged, and narrowed in the form of a beak or rostrum. They constitute the genus

PANORPA, Linnæus,—

And have the antennæ setaceous, and inserted between the eyes; the clypeus prolonged into a corneous conical plate, grooved beneath to receive the mouth; the mandibles, maxillæ, and lower lip nearly linear; four or six short filiform palpi; those of the maxillæ appearing to me to consist of only four joints. The body is long, the head vertical, the first segment of the thorax very small and collar-like. The two sexes differ greatly in many species. Their transformations have not been observed.

Nemoptera, Latr., Oliv., has the hind-wings exceedingly long and linear, and the ocelli are wanting. These singular insects have hitherto been only observed in the hottest parts of Europe, Africa, and the adjacent parts of Asia. [See the recent monograph of Klug in the *Berlin Transactions*.]

Bittacus, Latr., has the four wings of equal size, as well as ocelli; the abdomen is alike in both sexes, and the legs long and terminated by a single tarsal unguis. [Exotic species.]

Panorpa, Latr., has wings and ocelli like those of Bittacus, but the abdomen of the male is terminated by a long, jointed, recurved tail, with a claw at the tip; and that of the female is long, and pointed at the tip. The legs are of moderate length, and the tarsi have two ungues.

Fig. 107.—Panorpa communis.

Panorpa communis, Linn., is a very abundant species, found in hedges and woods. [Several other British species,]

Boreus, Latr., differs from the preceding in the large size of the prothorax; the wings of the males are short, curved, and awl-shaped, and the females are wingless. The only species, *B. hiemalis*, Linn., is found in winter under moss in the north of Europe, and on the Alps. [It is small, and has occurred, but rarely, in this country.]

2. The *Myrmeleonides*, having also five joints in the tarsi, but in which the head is not prolonged in the form of a beak or muzzle, and the antennæ are thickened at the tips. The head is transverse and vertical, having only compound eyes, which are round and prominent; six palpi, those of the labium being longer than the others, and thickened at the tips; the first segment of the thorax is small; the wings of equal size, long, and roof-like; the abdomen mostly long and cylindric, with two filiform appendages at its extremity, in the males; the legs are short. They inhabit hot situations in the southern climates of both hemispheres, clinging to plants, where they remain stationary during the day. They fly swiftly. Their pupæ are inactive. These insects compose the genus

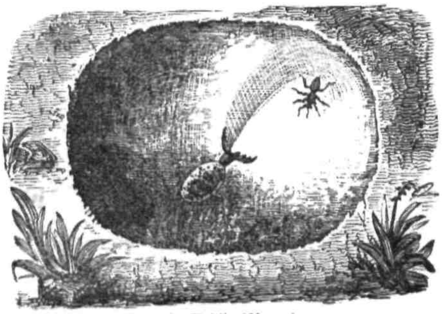

Fig. 108.—Pitfall of Myrmeleon.

MYRMELEON, Linn.,—

Which Fabricius has divided into two.

Myrmeleon proper, has the antennæ gradually thickened, curved at the tips, and much shorter than the body, and the abdomen is long and linear.

The destruction which the larva of the common European species makes amongst Ants, has gained for it the name of the *Ant Lion*. Its abdomen is very large, proportioned to the rest of its body; its head is very small, and armed with two long horn-like mandibles, toothed on the inside and pointed at the tip, which serve it both for pinchers and suckers. Although furnished with six legs it walks but slowly, almost always backwards: not being able, therefore, to follow its prey, it resorts to stratagem, and forms in the sand a conical

pit-fall, by crawling backwards in a spiral direction and throwing out the sand with its head, and at the bottom of which it stations itself, leaving only its jaws exposed, its body being buried in the sand, and thus waiting patiently until an insect falls to the bottom of the pit, when it is instantly seized by the jaws and sucked to death; if it endeavours to escape, the Ant Lion showers sand after it, which rarely fails to bring it to the bottom of the pit. The nutritive fluid thus obtained is never converted into excrement, the insect having no orifice analogous to the anus. When full grown, and ready to assume the pupa state, it spins a perfectly round cocoon of a silky matter, the exterior of which it covers with sand. Its spinnerets are placed at the extremity of the body. The perfect insect makes its appearance at the end of fifteen or twenty days, leaving the exuviæ of the pupa in the opening it has made in the cocoon.

Fig. 109.—M. formicarium.

The common European species, *M. formicarium*, Linn. [which has not, however, been discovered in England], is about an inch long, with the wings transparent, with black veins dotted with white, and with dark spots, one of a whitish colour near the anterior extremity. [The species are very numerous].

Ascalaphus, Fab., has the antennæ long, and suddenly terminated by a knob, with the abdomen oblong, oval, and scarcely longer than the thorax. The wings are shorter and broader than in Myrmeleon.

Bonnet observed a larva near Geneva similar to that of Myrmeleon, but which neither crawled backwards nor formed a pit. The posterior extremity of its body was furnished with a bifid plate, truncated behind. This larva is probably that of *Ascal. italicus*, a south of Europe species, which begins to be found in France in the environs of Fontainebleau. [This is probably doubtful, the larva being more likely to be that of *Myr. Libelluloides*. See my *Introd. to Mod. Classif. of Insects*, ii. p. 45, in which I have figured a larva of *Ascalaphus*, and subsequently Mr. Swainson has figured that of *Asc. Macleayanus*, from L. Guilding's drawings.]

3. The *Hemerobii*, Latr., similar to the preceding in the general form of the body and wings, but with filiform antennæ and only four palpi. They form the genus

HEMEROBIUS, Linn.,—

Some of which have the prothorax very small, the wings roof-like, the last joint of the palpi thickest, ovoid, and pointed. The larvæ are terrestrial.

Hemerobius proper, has the eyes globose and brilliantly metallic, the wings large and deflexed. They fly slowly, and many of them emit a disgusting scent. The females deposit their eggs upon leaves, to the number of ten or twelve, fixing each of them by a long and very slender footstalk. The larvæ resemble those of Myrmeleon, but are more elongate, and are wanderers. They feed upon the plant-lice, which they seize with their mandibles, and suck their juices, destroying them very quickly. The pupa is inclosed in a cocoon of close silk, spun from the anus of the larva. *Hemerobius* (*Chrysopa*, Leach,) *Perla*, Linn., is pale yellowish-green, with golden eyes, transparent wings, and green nerves. [A common species in this country].

Osmylus, Leach, is composed of those species which possess three ocelli, of which the preceding are destitute. *H. maculatus*, Fabr., [a local British species, of large size].

Nymphes, Leach, founded upon an Australian species, has the same character, but the antennæ are filiform and shorter. [*N. myrmeleonides*, Leach.]

The others have the first segment of the thorax large and corselet-like, the wings generally carried flat on the back, and the palpi filiform, with the terminal segment conical or nearly cylindric, and often shorter than the preceding. Their larvæ are aquatic.

Semblis, Fabr., is composed of the genera *Corydalis*, *Chauliodes*, and *Sialis*, Latr.

Corydalis, is distinguished by the mandibles, which are very large and like horns in the males. [*C. cornuta*, a North American insect.]

Chauliodes, Latr., has the antennæ pectinated; and

Sialis, has ordinary-sized mandibles, and the antennæ are simple and the wings roof-like. *S. lutarius*, Linn., [the May-fly, a well-known bait for anglers]. The larva lives in the water, and creeps or swims slowly, like those of the Ephemeræ: it has false branchiæ at the sides of the abdomen, aud the tail is elongated into a point; but it changes into an inactive pupa.

4. Another division, that of the *Termitinæ*, is composed of Neuroptera which undergo demi-metamorphoses, all being terrestrial, active, carnivorous or omnivorous, in all their stages. If we except *Mantispa*, (distinct from all the insects of the order in the form of the fore-legs, resembling those of Mantis), the tarsi have at most four joints, which distinguishes them from the preceding genera of the same family. The mandibles are always strong and horny, the hind wings are of the size of the fore wings, and without folds, or are smaller.

Some have from five to three joints in the tarsi, the labial palpi exserted and distinct, and the antennæ multiarticulate.

Mantispa, Illig., has five joints in all the tarsi; the fore-legs formed as in Mantis; the antennæ are very short,

the eyes large, the prothorax very long, and the wings roof-like. Exotic species, [recently monographed by Erichson, of great interest from their apparent relationship with the order Orthoptera].

Raphidia, Linn., has 4-jointed tarsi, the wings roof-like, the head elongated and narrowed behind, prothorax long, narrow, and subcylindric, and the abdomen of the females terminated by a long, exserted ovipositor, formed of two valves. *R. ophiopsis*, [the Snake-necked Fly, of rare occurrence in this country. See the monograph of Schummel]. The larva lives in the fissures of the bark of trees, and has the form of a small snake: it is very active.

Termes, Linn. (*Hemerobius*, Linn. [the winged males]), has also 4-jointed tarsi, but the wings are carried horizontally on the body, and very long; the head rounded, and the prothorax short and square. The body is depressed, with the antennæ short; the mouth very similar to that of the Orthoptera, with a four-cleft lower lip; three ocelli, one rather indistinct; the wings generally but slightly transparent, coloured, with the nervures not forming a close network, and the legs short.

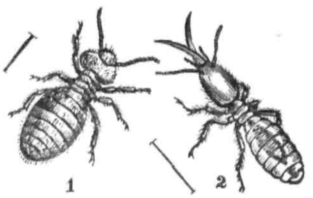

Fig. 110.—White Ants: 1, Worker; 2, Soldier.

The Termites peculiar to the tropical and adjacent countries, are known under the name of White Ants, and commit most extraordinary ravages, especially in the larva state, in which they are called Workers, and are like the perfect insect, but with the body softer and without wings, and the head generally larger, and destitute of eyes, or nearly so. They are united into colonies of incalculable numbers, and live concealed in the interior of the earth, trees, and other wooden matters, such as furniture, shelves, &c., in which they form galleries, forming routes conducting to the centre of their nests, so that these objects, of which the outer surface is [with surprising instinct] left untouched, fall to pieces on the slightest touch. The nests of some species are external, but without any evident exit. Sometimes they are elevated

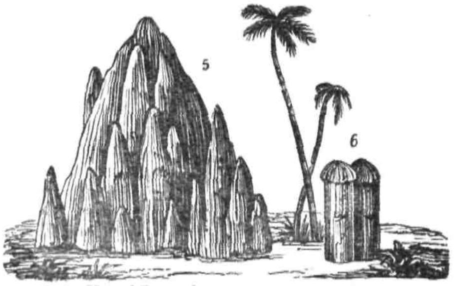

Fig. 111.—5, Nest of Termes fatale (ten or twelve feet high).—6, Nest of Termes atrox.

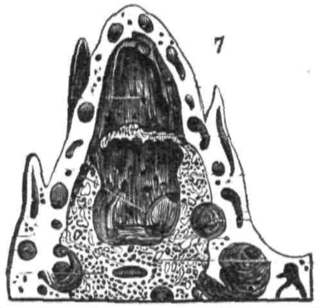

Fig. 112.—7, Section of the nest of Termes fatale, on a scale of one inch to eight feet

to a great height above the surface, like pyramids, and are sometimes surrounded by a solid roof, which, from the height and number of these insects, appear at a distance like a small village. Sometimes they affix their nests to the branches of trees. Another sort of individual, termed Neuters or Soldiers, and which Fabricius mistook for pupæ, defend the nest. They have the head much larger and longer, and the mandibles are very long and cross over each other. They are far less numerous than the larvæ, and live near the outer surface of the nest, so that they make their appearance first when it is attacked; they are also stated to compel the Workers to labour. The demi-nymphs have the rudiments of wings, and in other respects resemble the larvæ.

When arrived at the perfect state, the Termites quit their habitation, fly abroad during the evening or night in great numbers; they lose their wings before morning, which dry, and falling to the earth, they become the prey of birds, lizards, &c. The couples are then collected by the larvæ, which inclose each of them in a large cell; but Latreille conjectures that the act of coupling takes place in the air, as in the Ants, and that the females alone occupy the attention of the larvæ in order to the establishment of fresh colonies. The abdomen of the female subsequently acquires an enormous size, from the innumerable eggs which it contains. The royal chamber occupies the centre of the habitation, and around it are distributed those which contain the eggs and provisions.

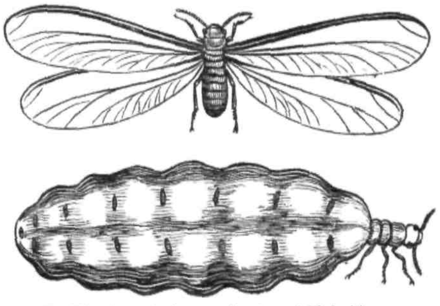

Fig. 113.—Queen in the winged state, and filled with eggs

Some larvæ of *Termes viarum* have eyes, and appear to have habits somewhat different to the rest, and to approach our Ants.

Negroes and Hottentots are very fond of these insects.

T. lucifugus and *flavicollis* inhabit the south of France, living in the interior of trees. The exotic species have been but imperfectly characterised, Linnæus having confounded several under the name of *T. fatale*.

Embia, Latr., comprises several insects allied to Termes, butwith the head larger than the thorax ; tarsi 3-jointed ; wings scarcely extending beyond the abdomen. [See my monograph on this exotic genus, published in *Transactions of the Linnæan Society of London*.]

The other Termitines have the tarsi 2-jointed ; the labial palpi indistinct, or very short ; the antennæ about 10-jointed ; the first segment of the thorax very small, and the hind wings smaller than the fore ones. They form the genus

PSOCUS, Latr. (*Termes, Hemerobius*, Fabr.),

These are insects with a short, soft, and gibbose body ; the head large ; the antennæ setaceous ; wings roof-like, and but slightly veined. They are very active, and live on the bark of trees. We generally find in books of collections of plants, the *P. pulsatorius*, of a whitish colour, and which has been believed to produce the slight noise like the ticking of a clock, often heard in houses, whence its specific name.

Fig. 114. — Atropos pulsatorius.

5. The *Perlides*, which have three joints in the tarsi, the mandibles almost always membranous and small, with the hind wings broader than the fore wings, and folded at the inner edge. They consist of the genus

PERLA, Geoff.,—

In which the body is elongate, narrow, and flattened ; the head rather large; antennæ setaceous ; prothorax nearly square ; the wings shutting horizontally on the body ; and the abdomen generally terminated by two setæ. Their larvæ are aquatic, and are stated [by Latreille, but erroneously,] to reside in cases which they bear about with them. [They are naked, and resemble the imago, but are wingless.]

Perla bicaudata, Linn. (*Phryganea*), is a rather common species, found on the margin of rivers.

Nemoura, Latr., differs from Perla in its corneous mandibles, and in the abdomen not being terminated by setæ. [See the monograph of this group, published by Mr. Newman in the *Magazine of Natural History*.]

THE THIRD FAMILY OF THE NEUROPTERA,—

THE PLICIPENNES, Latr.,—

Are destitute of mandibles, and their hind wings are generally broader than the superior, and folded throughout their whole length. They comprise the genus

PHRYGANEA, Linn.

They have at the first sight the appearance of small Phalænæ, and De Geer observed that the internal structure of their larvæ has great resemblance to that of caterpillars. In the systems of Kirby and Leach, they form the order Trichoptera, which is connected with the Lepidoptera by means of the Tineæ. But as we naturally pass from the Plicipennes to the Perlides, we should be compelled to terminate the Neuroptera with Libellula and Ephemera, of which the structure and habits greatly differ from those of the Hymenoptera, which succeeds them in this system. The Libellulæ and other adjacent Neuroptera, appear to us nearest allied to the Orthoptera.

The head of the Plicipennes is small, with two long setaceous and porrected antennæ ; the eyes are round and prominent ; two ocelli, placed in the forehead ; a conical or bent labrum ; four palpi, the maxillary pair being often very long, filiform, or nearly setaceous, 5-jointed, and the labial 3-jointed ; the maxillæ and lower lip membranous and united ; the body is generally very hairy, and forms with the wings an elongated triangle, as in many Noctuæ or Pyralides ; the prothorax is small ; the wings are simply veined, silken, or hirsute in many, and always roof-like. The legs are long, furnished with small spines, with five joints to all the tarsi. These insects chiefly fly in the evening or night, often entering our houses, attracted by the light, and being extremely active in all their movements. They emit a disagreeable smell when touched. The smaller species fly in troops over water. Many females carry their eggs united into a pacquet at the posterior extremity of the abdomen. Their larvæ [which are the well-known bait of the angler, called Caddice, or Cad-bait,] reside, like the larvæ of some moths, in cases generally cylindrical, covered with various substances they collect in the water, such as bits of straw, leaves, sticks, sand, and even small shells, often symmetrically arranged, and which they affix to their cases by silken threads, spun from internal reservoirs similar to those of caterpillars ; the interior of this habitation forms a tube, which the larva bears about with it, protruding the anterior part of its body when it creeps forward, never quitting it of its own accord, and immediately re-entering it if forced out of it.

These larvæ are elongate, nearly cylindric, with a scaly head furnished with strong mandibles, and a small eye on each side; six feet, of which the two anterior are shortest and thickest, and the other four longer; the body is composed of twelve joints, of which the fourth has a conical tubercle on each side in the majority of the species; the terminal segment is furnished with two moveable hooks; the majority also possess two series of white flexible filaments, which appear to be respiratory organs. When ready to assume the pupa state, they fix their cases to some substance under water, closing each end with an open grating, which, as well as the cases itself, varies in the different species.

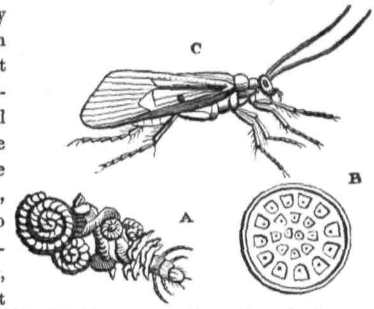

Fig. 115.—*Phryganea grandis*.—A. Larva in its case B. grating; C. Imago.

The pupæ have in front two hooks, which cross each other like a beak, and with which they make their way through the grating, [immediately before they assume their final form,] when, although previously immoveable, they walk or swim with agility, by means of their four fore-legs, which are free and fringed. The pupæ of the larger species crawl up plants out of the water, where they throw off their skin, but the smaller ones merely come to the surface, and are there transformed into winged insects in the same way as Gnats, their old envelope serving them for a boat.

Some have the hind wings evidently larger than the fore ones, and folded.

Sericostoma, Latr., has in one of the sexes the maxillary palpi dilated into a mask covering the face; in the other sex they are filiform, and 5-jointed.

Phryganea proper, has the mouth alike in both sexes, and the palpi shorter than the head and thorax, and slightly villose. *P. grandis*, [and a great number of other species, well known to the angler and fly-fisher].

Mystacida, Latr., has the antennæ exceedingly long, as well as the maxillary palpi, which are very hairy. (*P. filosa, quadrifasciata*, &c.)

The others have the fore wings narrow, lanceolate, subequal, and not folded.

Hydroptila, Dalm., with short antennæ of equal thickness throughout.

Psychomyia, Latr., has similar wings, but the antennæ are long and setaceous, founded upon a minute, apparently undescribed species.

[This tribe has recently been thoroughly investigated by M. Pictet, whose memoir forms a thick quarto volume, with many plates. Messrs. Stephens and Curtis have also described many new English species, as well as additional genera.

Dr. Burmeister has published an entire revision of the order Neuroptera in the last part of his *Handbuch der Entomologie*, in which he has also established many additional genera.]

THE NINTH ORDER OF INSECTS,—

THE HYMENOPTERA, Linnæus (PIEZATA, Fabricius),—

Also possesses four membranous, naked wings, a mouth furnished with mandibles, maxillæ, and two lips; but the wings (of which the anterior are always the largest) have fewer nervures than those of the Neuroptera, and are only veined [and not net-like]; the females have the abdomen terminated by an ovipositor or a sting. All possess, in addition to their compound eyes, three minute ocelli; their antennæ are of variable form, not only differing in the genera, but also in the sexes of the same species; they are nevertheless filiform or setaceous in the majority; the maxillæ and lower lip are generally narrow, elongated, attached in a deep cavity of the head by long muscles*; semitubular at the base; often folded back at the extremity; more fitted for conducting the nutritive fluids than for mastication, and united in many in the form of a proboscis; the tonguelet is membranous, and either widened at the tip or long and filiform, having the pharynx at its base, and often covered by a sort of sublabrum or epipharynx; two labial and two maxillary palpi; thorax composed of three segments united in

* Hence the mentum partakes of this general movement; in other biting insects it is fixed.

a mass, the anterior being very short and the two others united into one.* The wings are crossed horizontally upon the body; the abdomen mostly suspended to the hind part of the thorax by a slender thread or peduncle; the tarsi are 5-jointed, none of the joints being bilobed. The borer or sting [both of which are described in a note as being typically composed on the same model], are formed for the most part of three long and slender pieces, two of which serve as a sheath to the third in those which have a borer, and of which the upper has a groove at its under side to encase the two others.

M. Jurine has found in the articulation [of the nerves] of the wings good auxiliary characters for the distinction of genera, making use of the presence or absence, number, form, and connexion of the two kind of cells situated near the external apex of the fore wings, which he terms radial [or marginal], and cubital [or submarginal] cells. The middle of the fore margin of the wings has often a callous spot, termed the stigma, whence a nerve extends which runs to the tip of the wing, and forms with the fore-edge of the wing the radial cell, sometimes divided into two; a second nervure also extends from the stigma, which also extends to the apex of the wing, leaving between it and the first-mentioned nerve a space occupied by the cubital cells, of which the number varies from one to four.

The Hymenoptera undergo a complete metamorphosis; the majority of their larvæ are vermiform, and are destitute of feet, such as those of the second and followingfamiles; those of the first family have six hooked feet, and often from twelve to sixteen others, which are simply membranous; the head in all is scaly, with mandibles, maxillæ, and a lower lip, at the extremity of which is a spinneret for the passage of the silken matter of which the cocoon of the pupa is composed. Some feed upon vegetable substances; others, always footless, upon the dead bodies of insects, in all their states of egg, larva, pupa, and imago. In order to supply their weakness, the female supports them with provisions, sometimes carrying their food to the nests which they have prepared for them, often with surprising skill, and sometimes by placing their eggs in the bodies of larvæ and pupæ of insects, upon which their young feed. Other equally footless larvæ of Hymenoptera are fed on more elaborated animal and vegetable food, and more constantly renewed. These are reared in common by individuals destitute of sex, united in societies, charged exclusively with such works, and whose labours and regime are the theme of continual admiration. The Hymenoptera in the perfect state subsist almost exclusively on flowers, and are commonly most abundant in southern climates. The extent of their existence, from their birth till their final change, is confined to a year.

[The natural classification of these insects has been but comparatively little attended to. Various plans of arrangement, founded not only upon the structure of the imago, but also upon its habits, and the peculiarities of the preparatory states, have recently been proposed by Saint Fargeau, Dahlbom, Hartig, Haliday, &c. I must however refer to the 2nd vol. of my *Introduction to Entomology* for an investigation of these arrangements.

I divide this order into two sections, [TEREBRANTIA and ACULEATA].

The first, that of the *Terebrantia*, is characterized by possessing a borer in the females.

I divide the Terebrantia into two great families, [the *Securifera* and *Pupivora*].

THE FIRST FAMILY OF THE HYMENOPTERA,—

THE SECURIFERA,—

Is distinguished from the following by the sessile abdomen, of which the base is united to the thorax by its entire width, and appears to be but a continuation of it, without any proper motion. The females have an ovipositor, for the most part like a saw, which is used not only in depositing the eggs, but also in preparing a place for their reception. The larvæ have always six scaly feet, and often

* In a note Latreille adopts the theory that the metathorax is a very narrow segment, and that the hind part of the thorax which has two spiracles at the sides, is in reality the first abdominal segment, so that in the pedunculated Hymenoptera, the peduncle is the second and not the first abdominal segment.

others, but which are membranous. This family is composed of two tribes, [the *Tenthredinetæ* and *Urocerata*].

THE TENTHREDINETÆ—,

Or Saw-flies [as they are commonly called, from their saw-like ovipositor], have the mandibles long and compressed, the lower lip divided into three lobes, the ovipositor composed of two plates, toothed like a saw, united, and lodged in a channel beneath the anus; the maxillary palpi are always composed of six joints, and the labial of four; the wings are always divided into numerous cells. This tribe is composed of the genus

TENTHREDO, Linn.

The abdomen is cylindric, rounded behind, 9-jointed; the form of the antennæ varies; the mandibles are strong and toothed; the maxillary palpi are filiform and 6-jointed; the lower lip is divided at the apex into three lobes; the labial palpi are only 4-jointed. It is with the alternate motion of the saws of the ovipositor that these insects make a succession of small holes in the branches or other parts of trees, in each of which an egg and a drop of frothy liquid are discharged, the latter of which has the effect of closing the hole. The wound thus made becomes more and more convex by the increase in size of the egg, and sometimes these parts assume the form of a gall, either woody or pulpy, according to the parts injured; these tumours form the abode of the larvæ which reside within them, and the insect makes with its teeth a circular hole for its escape. But in general these larvæ are external feeders, devouring the leaves. They greatly resemble the Caterpillars of Lepidopterous insects, but have from eighteen to twenty-two feet, or only six, which distinguishes them from caterpillars, which have from ten to sixteen feet. Many of these false caterpillars roll themselves into a spire, and others have the extremity of the body elevated in the air. In order to undergo their change, they spin, either on the earth or on the plants upon which they have fed, a cocoon, in which they remain unchanged for many months, changing to pupæ only a few days before they become perfect Sawflies.

Some, in many of which the antennæ are not more than nine-jointed, with two spurs at the tip of the fore tibiæ, have the ovipositor not exserted, the labrum apparent, the inside of the four hind tibiæ without spines in the middle, or with only one; the larvæ have from twelve to sixteen false legs.

Fig. 116.—Cimbex fasciata, (Zaræa fasciata, Leach).

Cimbex, Oliv. (*Crabro*, Geoffr.), comprises those species which have the antennæ alike in both sexes, and terminated by a knob or a reversed cone rounded at the tip, preceded by four or five joints, and the two subcostal nerves are contiguous without a wide intermediate space. The larvæ have 22 feet; some when disturbed discharge from pores of the body, often to the distance of a foot, drops of a greenish liquid. Dr. Leach has divided this genus into numerous others [adopted by English authors], founded upon the number of joints in the antennæ preceding the club, their relative sizes, and the arrangement of the cells of the wings.

Perga, Leach, (one of these genera), peculiar to New Holland, differs from the rest by having the four posterior tibiæ furnished with a moveable spine in the middle, the posterior angles of the scutellum produced into short obtuse teeth, the antennæ very short and 6-jointed.

Syzygonia, Klug, has also 6-jointed antennæ, and the radial cell is appendiculated. The species are Brazilian, as well as those of *Pachylosticta*, Klug, which have antennæ composed of five joints, and the fore-wings dilated near the apex.

Saint Fargeau, in his work on the *Tenthredinidæ*, adopts only the genus *Perga*, and we also consider the genera of Leach as simple divisions in the genus *Cimbex*, the type of which is the *Tenthredo femorata*, [a large and rare British species].

Hylotoma, Latr. (*Cryptus*, Jur.), has the antennæ apparently only 3-jointed, the third forming a long prismatic or cylindric mass; the greater number have a spine on the inside of the four hind tarsi, in the middle. The larvæ have from eighteen to twenty feet. Type, *Tenthredo Rosæ*, Linn., [a common British species].

Schizocerus, Latr. (*Cryptus*, Leach), has four submarginal cells, and the male antennæ forked.

Ptilia, St. Farg., differs from Hylotoma in having only three submarginal cells. Sometimes the antennæ have at least nine joints, and do not terminate in a mass.

Tenthredo proper, have nine simple joints in both sexes; the larvæ have from 18 to 22 feet. The number of teeth in the mandibles varies in the perfect insect from two to four; the wings also vary in the number of the cells, and hence various subgenera have been established, such as *Allantus*, *Dolerus*, *Nematus*, Jur., and *Pristiphora* and some others of Leach, [such as *Selandria*, *Fenusa*, *Dosytheus*, *Emphytus* and *Crœsus*]. Type, *T. Scrophulariæ*, Linn., a common species, much resembling a Wasp, the larva of which feeds on the Water Betony. De Geer has described a singular species, which in the larva state infests the leaves of our fruit trees under the form of a small black slug, and to which he refers the *Tenthredo Cerasi*, Linn.; this larva is black, and covered with a slimy secretion. Peck, an American naturalist, has given the complete history of another species, which has a similar larva.

Cladius, Klug, has also 9-jointed antennæ, but those of other males are pectinated on one side. [*C. difformis*, a small black species, rather uncommon.]

Athalia, Leach, has the body short, and the antennæ from 10 to 14-jointed, and simple in both sexes. [*A. centifoliæ*, Panz., is extremely destructive to turnips, its larva being known under the name of the Nigger, or Black Jack.]

Pterygophorus, Klug, has the antennæ more than 16-jointed, with a single row of teeth in the males, and serrated in the females, [composed entirely of Australian insects].

Lophyrus, Latr., has the male antennæ furnished with a double row of long branches, and serrated in the females. The larvæ have twenty-two feet, and live in society, especially upon firs and pines.

In the following genera the labrum is hidden, or but little exposed; the inner edge of the four posterior tibiæ has often two spurs in the middle, and often a third above the preceding pair. The antennæ are always composed of a great number of joints.

Megalodontes, Latr. (*Tarpa*, Fab.), have the antennæ serrated or comblike.

Pamphilius, Latr. (*Lyda*, Fab.), has the antennæ simple in both sexes. Their larvæ have no membranous feet, and the posterior extremity of the body is terminated by two horns. They feed upon leaves, which they often roll up and fasten together.

The terminal Tenthredinetæ have the ovipositor extended beyond its sheath, and exposed posteriorly; the inner extremity of the two fore-tibiæ has only a single spur, which is bent, and terminated by two teeth; the antennæ are always composed of a great number of joints, and are simple.

Xyela, Dalm. (*Pinicola*, Breb., *Mastigocerus*, Klug), is very distinct, from its elbowed antennæ suddenly attenuated towards the tip, 11-jointed, the third joint being exceedingly long, as well as the maxillary palpi; the stigma is replaced by a cell. The larvæ live in the interior of vegetables, or in old wood. [These are small and singular insects, one species of which, *X. pusilla*, has occurred, but very rarely, in this country.]

Cephus, Latr. (*Trachelus*, Jur.), has the antennæ inserted near the forehead [not elbowed], and thickened at tip. From some observations published in the *Bulletin Universel* of Ferussac, it appears that the larva of the most common species, *C. pygmæus*, lives in the stems of wheat.

Xiphydria, Latr. (*Urocerus*, Jur.), has the antennæ inserted near the mouth, and more slender at the tips. [This genus naturally belongs to the family *Urocerata*, the construction of its ovipositor agreeing with that of Urocerus; the larvæ also live in solid wood. The imago is remarkable for the great length of its neck, whence the names of the typical species, *X. camelus* and *Dromedarius*.

[The student must especially consult the monograph on this family published by Saint Fargeau, the numerous memoirs of Klug in the *Berlin Magazine*, various works of Dahlbom and Hartig, the two last of whom have studied the family with great care, and especially with reference to their transformation. Mr. Stephens has described the British species in his *British Entomology*.]

The second tribe, that of the

UROCERATA,—

is distinguished from the preceding by the following characters: The mandibles are short and thick; the lower lip entire; the ovipositor of the females is either very much exserted, and composed of three threads, or spirally coiled in the interior of the abdomen and capillary This tribe is composed of the genus

SIREX, Linn.,—

The body of which is nearly cylindric, the head nearly gobular. The females deposit their eggs in old trees, especially of fir; the ovipositor is lodged at its base, between two valves, forming a sheath.

Oryssus, Latr., has the antennæ inserted near the mouth, 10 or 11-jointed; the mandibles are without teeth; the maxillary palpi long and 5-jointed; the posterior extremity of the body nearly rounded, and the ovipositor capillary, and spirally coiled within the abdomen. The two species [known to Latreille] are found in Europe upon trees early in spring, and are very active. [The typical species, *O. coronatus*, has been found in this country.]

Sirex proper (*Urocerus*, Geoffr.), has the antennæ inserted near the forehead, with from 13 to 25 joints; the mandibles toothed internally; the maxillary palpi very small, nearly conical, and 2-jointed, with the extremity of the abdomen prolonged into a horn, and the ovipositor exserted and formed of three threads. These insects are of large size, and generally inhabit pine forests in cold and mountainous countries, and produce during flight a buzzing noise like that of the Humble Bees. In certain seasons they appear [in such countries] in such abundance that they become objects of popular dread. The larvæ have six feet, with the posterior extremity of the body terminated in a point; they live in wood, where they spin a cocoon and undergo their transformations. [Saint Fargeau, contrary to the statements of the German naturalists, who have such abundant opportunities of studying the manners of this genus, has endeavoured to show that these insects are parasites. Typical species, *Sirex gigas*, Linn. (*S. mariscus*, L., the male); it has occurred in this country, but very rarely, and is as large as a Hornet.]

Tremex, Jur., differs in having shorter antennæ, composed of only thirteen or fourteen joints, and in the fore-wings having only two cubital cells.

THE SECOND FAMILY OF THE HYMENOPTERA,—

THE PUPIVORA,—

Has the abdomen attached to the thorax by a small portion only of its transverse diameter, and often by a slender peduncle, so that its mode of insertion is very distinct, and it is easily bent over the thorax. The females are armed with a borer, which serves them as an oviduct.

The larvæ are footless grubs, and are, for the most part, parasites, and carnivorous.

I divide them into six tribes.

The first tribe, EVANIALES, Latr., has the wings veined, and the superior, at least, areolated; the antennæ, filiform or setaceous, 13-or 14-jointed; the mandibles toothed internally; the maxillary palpi 6-jointed, and the labial 4-jointed; the abdomen implanted high on the thorax, and often beneath the scutellum, with the ovipositor generally exserted, and composed of three threads. This tribe may be formed into a single genus,

FŒNUS.

Evania, Latr., has the ovipositor internal, the antennæ elbowed, and the abdomen very minute, compressed, pedunculated, and attached at the upper and posterior extremity of the thorax, close to the scutellum. [*E. appendigaster*, Latr., a small species, regarded as parasitic upon the Cockroach.]

Pelecinus, Latr., has the abdomen sometimes very much elongated, filiform, and arched, sometimes narrowed gradually towards the base and terminated in a club; the posterior tibiæ are thickened, and the ovipositor not exserted. [Singular American insects.]

Fœnus, Fabr., has the ovipositor long, exserted, and formed of three long and equal threads, and the abdomen and posterior tibiæ clavate, and the antennæ filiform. [Two British species.]

Aulacus, Jur., has the abdomen compressed, the tibiæ slender, and the antennæ setaceous. [Several continental and American insects.]

Paxylloma, Brebisson, has the abdomen sickle-shaped. [This genus is arranged by subsequent authors amongst the *Ichneumones adsciti*. Latreille had noticed its great relation with *Ophion*. *P. buccata*, the type, has occurred in this country.]

The second tribe, the ICHNEUMONIDES, have the wings also veined, the superior always exhibiting in the disc perfect or closed cells; the abdomen is affixed between the two hind feet; the antennæ are generally filiform or setaceous, (very rarely clavate,) vibratile, and composed of a great number of joints (16 at least). In the majority the mandibles have no tooth on the inside, and are terminated in a bifid tooth. The maxillary palpi are always apparent, or prominent, and have mostly only five joints. The ovipositor is composed of three threads.

This tribe embraces nearly the whole of the genus

ICHNEUMON, Linn.,—

Which destroy the progeny of Lepidopterous insects, so injurious to the agriculturist, under the form of Caterpillars, in the same manner as the Ichneumon quadruped was supposed to destroy the Crocodile, by depositing its eggs in its entrails.

The old authors named these insects *Muscæ tripiles*, on account of the three threads of the ovipositor; and *Muscæ vibrantes*, because they continually vibrate their antennæ, which are often curved, with a white or yellow ring in the middle. They have long maxillary palpi, nearly setaceous, 5- or 6-jointed, the labial being shorter, and 3- or 4-jointed. The tonguelet is generally entire, or simply emarginate. The body has generally a narrow and elongated or linear form, with the ovipositor sometimes exterior and like a tail, and sometimes very short, and hidden in the interior of the abdomen, which is terminated in a point, whereas it is thickened and obliquely truncate in those which have the ovipositor exposed. Of the three pieces of which it is composed the middle piece is the only part which penetrates into the body, in which the eggs are deposited; its tip is often slit like the point of a pen. The females, when ready to deposit their eggs, run or fly about in order to discover the larvæ, pupæ, or eggs of insects, and even of Spiders, Plant Lice, &c., destined to receive the eggs and to nourish the young Ichneumons, exhibiting in these searches an admirable instinct, in order to find the objects of their search in their most concealed retreats. It is [in caterpillars, &c., which live] beneath the bark of trees, or in their crevices, that those with an elongated ovipositor place their eggs [in the manner represented in the annexed figures]; whilst those with a short ovipositor place

their eggs in or upon the bodies of naked caterpillars, or pupæ, to which they can obtain easy access. The larvæ of the Ichneumons have no feet, and thus resemble those of the following families. Those which reside, like intestinal Worms, inside the bodies of other insects, sometimes in society, devour only the fatty parts of the body, being the portions not absolutely necessary for existence; but when ready to assume the pupa state they pierce through the outer skin, or else they kill their victim and undergo their own changes in its body. The majority spin a silken cocoon, in which the pupa is inclosed. These cocoons are sometimes united in a mass, sometimes naked, and sometimes enveloped in a common cottony mass, often seen attached to the stems of plants. Their union and arrangement forms a mass sometimes resembling a piece of honey-comb. These cocoons are sometimes of a uniform whitish colour, and sometimes banded; some cocoons are suspended to the leaves of trees by a long thin thread.

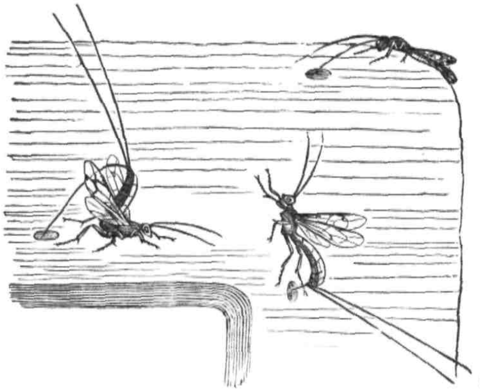

Fig. 117.—Pimpla manifestator, depositing its eggs.

This family is extremely numerous in species. [Gravenhorst, in his *Ichneumonologia Europæa*, describes nearly 1650 species of European *Ichneumones genuini;* and Stephens and others have added greatly to their number. The *Ichneumones adsciti* are probably as numerous; so that, supposing the number of species in the world to be double that of those found only in Europe, we shall have more than 6,000 Ichneumonidæ; a number which, although very extraordinary, is probably far below the actual amount.]

The variation in the number of joints in the palpi may serve as the basis for the principal divisions in the family. [This character has been proved by Haliday and Nees von Esenbeck to be inapplicable to the *Ichneumonides adsciti.*]

The first comprises those species which have the maxillary palpi 5-jointed, and the labial 4-jointed; the second cubital cell is very minute, and nearly circular, or wanting.

A first subdivision is formed with the species which have the head not prolonged into a beak; the labrum not deeply notched; the maxillary palpi very long, and the ovipositor not covered at the base by a large vomeriform plate.

Some of these have the ovipositor exserted.

Stephanus, Jur. (having the thorax very narrow in front, and the antennæ attached to the posterior and superior part of the metathorax, as in the Evaniæ,—exotic insects), and

Xorides, Latr. (having the metathorax convex and armed at the apex, so that the abdomen is attached in the ordinary manner with a distinct peduncle), differ from the others by having the head nearly globular, the mandibles terminated in an entire point or slightly emarginate. The second cubital cell is often obsolete.

The others have the head transverse, and the mandibles distinctly bifid at the tip. Some, as

Pimpla, Fab., have the abdomen cylindrical and very shortly peduncled. [Numerous British species.] Type, *Ichneumon persuasorius*, Linn. Another species (*P. ovivora*, Bull. Ferussac), destroys the eggs of Spiders.

Cryptus, Fab., has the abdomen nearly oval, with a long curved peduncle. Some of the species are apterous, whence, as well as from the form of the thorax divided into two nodes, they should constitute a distinct subgenus. They are always found on the ground. [They constitute the subgenus *Pezomachus*, Gravenhorst, who has published a monograph upon them.]

Others have the ovipositor of the females hidden, or but little extended beyond the anus.

Ophion, Fab., has the abdomen sickle-shaped, the antennæ filiform or setaceous; the ovipositor is slightly exserted. The second cubital cell is very small. Type, *Ichneumon luteus*, Linn., [a common British species], the female of which deposits her eggs on the body of the larva of the *Bombyx vinula*, fixing them by means of a long peduncle. The larva of *O. moderator*, Fab., destroys that of another Ichneumon, *Pimpla strobilellæ*, Fab.

Banchus, Fab., has similar antennæ, but the abdomen is gradually narrowed to the tip. [*B. pictus*, Fab., a common British species.]

Hellwigia, Gravenh., have the appearance of the preceding, but the antennæ are clavate. [A continental species.]

Joppa, Fab., differs from the following in having the antennæ dilated in the middle, and pointed at the tip [Exotic species.]

Ichneumon proper, has the head transverse, the abdomen oval, nearly equally narrowed at each end. [Numerous British species.] Panzer has separated, under the name of *Trogus*, those species which have the scutellum in the form of a conical tubercle, and the abdomen marked by deep transverse impressions.

Alomyia, Panzer, has the head narrower and more rounded, with the abdomen more dilated towards the posterior extremity.

Hypsicera, Latr. [*Tryphon* (*Exochus*) Grav.], has the appearance of Alomyia, but is remarkable for its pyramidal head, with a frontal elevation supporting the antennæ.

Peltastes, Illig. (*Metopius*, Panzer), has the abdomen united to the thorax by the greater part of its transverse diameter, subsessile, and slightly dilated towards the extremity. *Ichn. necatorius*, Panz. [and two or three allied British species]. They have a circular elevation beneath the antennæ.

The second and last division of the species with 5-jointed maxillary and 3-jointed labial palpi has the labium deeply notched, and the ovipositor is exserted and covered at the base by a vomeriform plate; the hind thighs are thick.

Acœnitus, Latr., has the front of the head not produced into a beak. In

Agathis, Latr., it forms a beak. These insects approach in their wings the following subgenera.

Our second division of the Ichneumons differs from the preceding in respect to the joints of the palpi only, in consequence of the labial palpi having only three joints, as in the majority of the species of the following division; the second cubital cell is nearly as large as the first, and nearly square; the ovipositor is exserted; the tip of the mandibles is bifid or notched.

Bracon, Jur., has an evident hiatus between the mandibles and clypeus; the maxillæ are prolonged inferiorly beneath the mandibles; the second cubital cell is square and rather large; the ovipositor is long; the antennæ are setaceous, as long as the body, and the maxillary palpi are much longer than the labial.

Vipio, Latr., has the antennæ shorter and filiform; the maxillæ are proportionably larger, and form a kind of beak, and the maxillary palpi are not much longer than the labial.

Microgaster, Latr., does not exhibit any decided hiatus between the mandibles and clypeus; the maxillæ and lower lip are not prolonged; the second cubital cell is small. The ovipositor as well as the abdomen is short.

Our third and last division, corresponding with the genus *Bassus* of M. Esenbeck, has like the preceding, four joints in the labial palpi, but the maxillary palpi are 6-jointed; the abdomen is semi-sessile.

In some the mandibles are gradually narrowed to the tip, and terminated by two teeth.

Helcon, Nees, has the abdomen, seen from above, composed of several joints, and terminated by a long ovipositor.

Sigalphus, Latr., has the abdomen vaulted beneath, and only 3-jointed above, with the ovipositor withdrawn and sting-like.

Chelonus, Jur., has the abdomen similarly formed beneath, but inarticulated on its upper suface.

Alysia, Latr., has the mandibles nearly square, with three teeth at the tip, one in the middle, and the two others formed by the produced angles of the terminal margin.

[The investigation of the Ichneumonidæ, since the death of Latreille, has been greatly attended to; the great work of Gravenhorst has made us acquainted with the *Ichneumones genuini*, or those which composed Latreille's first division, whilst the *Ichneumones adsciti*, or those composing the two other divisions of Latreille, have been described by Dr. Nees Von Esenbeck, Professor Wesmael of Brussels, and Mr. Haliday, in various memoirs and separate publications, in which a great number of genera are added to those noticed in the text.]

The third tribe, GALLICOLÆ (*Diploleparia*, Latr.) has only a single nerve in the hind wings; the upper wings possess a few cells or areolets: namely, two brachial cells at the base, the internal one being generally incomplete or but slightly distinct, one radial and triangular, and two or three cubital; the second in those which have three, being always very small, and the third very large, triangular, and closed by the external margin of the wing. The antennæ are thickened at the tip, but not forming a mass, and mostly from 13- to 15-jointed; the palpi are very short, [not very long, as described by Latreille]. The ovipositor is rolled spirally up in the interior of the abdomen, with the posterior extremity lodged in a slit of the belly; the Gallicolæ form the genus

CYNIPS, Linn.,—

Which Geoffroy inconsiderately named *Diplolepis*, and gave the name of *Cynips* to insects of the following family, united by Linnæus with the terminal division of the Ichneumons.

The abdomen is compressed, the thorax very much elevated, the ovipositor of the females appears to consist of a single long and very delicate piece, rolled up spirally at the base, and the terminal part being lodged beneath the anus, between two elongated valves, each forming a demi-sheath. The extremity of this ovipositor is channelled with lateral teeth, with which the insect enlarges the slits

made in various vegetables in order to deposit its eggs; the fluid accumulating in the wounded part of the plant forms excrescences or tumours, which have been termed galls or nut-galls, the latter of which is employed with a solution of green vitriol, or sulphate of iron, in producing a black dye.

The form and solidity of these galls vary according to the nature of the parts of the plants which have been attacked, as the leaves, petioles, buds, bark, roots. Many are spherical, and resemble fruits, such as gall-apples, &c.; others are hairy, as the bedeguar of the rose; others resemble small artichokes, fungi, &c. The eggs inclosed in these galls increase in size and consistence. They give birth to small larvæ destitute of feet, but furnished with tubercles to supply their stead; sometimes they live singly, and sometimes in societies. [I have obtained more than eleven hundred gall-flies from a single gall, found at the root of an oak]. They devour the interior without stopping its growth, and remain five or six months in that state. Some undergo their changes within the galls, but others quit them in order to descend into the earth. The small round holes observed in the sides of the galls, show that the insect has made its escape: various insects of the following family are also found within, but these have taken the place of the real inhabitants, having destroyed them in the same manner as the Ichneumons.

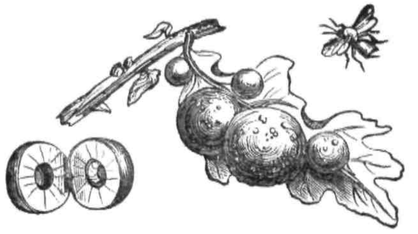
Fig. 003.—Oak gall-apple and Cynips quercusfolii.

An insect [considered to belong to this family] deposits its eggs in the seeds of the most forward wild figs in the Levant. The modern Greeks, following a custom handed down to them by their forefathers, fasten several of these fruits, amongst the later figs, the insects escaping from which, covered with the fecundating dust, make their way into the eye of the fruit of the latter, and thus provoke the maturity of the fruit. This operation is termed caprification.

Ibalia, Latr. (*Sagaris*, Panz.), has the abdomen very compressed, like the blade of a knife; the antennæ filiform; the radial cell is long and narrow, and the two brachial ones very distinct; the two anterior cubital cells are very small. [*I. cultillator*, Latr., a very rare British species.]

Figites, Latr., has the abdomen ovoid, thick, and rounded above, compressed beneath; the antennæ moniliform, and thickened to the tips. There is only one complete brachial cell; the radial cell is far from the tip of the wing, and the second cubital is wanting.

Cynips proper (*Diplolepis*, Geoff.), has the abdomen similar, but the antennæ are filiform, and there are three cubital cells; the radial cell is also more elongate. *C. Gallæ tinctoriæ*, Oliv., resides in a sound hard tubercular gall found upon a species of oak in the Levant, and which is used in commerce, [and which is our chief ingredient in the manufacture of ink]. By breaking the galls, the perfect insect may occasionally be obtained. *C. Quercus pedunculata*, punctures the male flower-stalks of the oak, and produces small galls in bunches, like bunches of currants. [See, for numerous additional genera and species, the memoirs of Boyer de Fonscolombe, Walker, Westwood, and especially Hartig, published in the 3rd number of the *Zeitschrift fur die Entomologie.*]

The fourth tribe (CHALCIDIÆ, Spin.), differs only from the preceding in having the antennæ elbowed (except in Eucharis), and forming beyond the angle an elongated or fusiform mass; the basal joint is often lodged in a groove [of the face]; the palpi are very short; the radial cell is generally wanting, and there is only a single cubital cell, which is not closed. The antennæ have not more than twelve joints. The genera hitherto established may be referred to that of

CHALCIS, Fabr.

These insects are very small, ornamented with brilliant metallic colours, and possess, in general, the power of leaping. The ovipositor is mostly composed of three threads, as in the Ichneumons, and exserted. The larvæ are similarly parasites. Some, in consequence of their minute size, feed on the eggs of insects which are scarcely perceptible; many others live in the larvæ and chrysalides of Lepidoptera. I presume that they do not weave a cocoon in order to become pupæ.

Some, having always 11- or 12-jointed antennæ, have the hind thighs very thick, lenticular, with the tibiæ curved; of these, some have the abdomen attached to the thorax by a foot-stalk, with the ovipositor straight, and rarely exserted.

Chirocera, Latr, has the male antennæ feathered like a fan. *C. pectinicornis*, Latr.

Chalcis, Fabr., has the antennæ single in both sexes; of these some have the peduncle elongated. [*C. sispes*, a British species.] In others, the peduncle is very short, (*Vespa minuta*, Fabr.) [a British species]. *C. annulata*,

which resides in the card-nests of one of the wasps of South America, and which Réaumur considers as the female of this wasp.

Dirhinus, Dalm., has the head deeply bifid and prolonged in front, as well as the mandibles. [*D. excavatus*, Dalm., an African species.]

Palmon, Dalm., composed of species found in copal, has the antennæ terminated by three thick joints, and the ovipositor exserted.

Leucospis, Fab., has the abdomen applied against the hind part of the thorax, rounded behind, with the ovipositor curved over the back. The female of *L. dorsigera* places its eggs in the nests of Mason Bees; that of *L. gigas* oviposits in Wasps' nests.

The others have the antennæ mostly only from 5- to 9-jointed, with the hind thighs oblong, and the tibiæ straight.

Eucharis, Latr., with straight 12-jointed antennæ, and, according to Latreille, without any vestige of palpi.

Thoracantha, Latr., Brazilian insects, with the scutellum extended over the abdomen.

The remainder have the antennæ at least 9-jointed, simple, and elbowed, and scutellum small.

Of those which have the antennæ not inserted close to the mouth, some have the abdomen nearly ovoid, compressed at the sides, and the ovipositor mostly exserted.

Agaon, Dalm., has the head very large and flat, and the basal joint triangular. [*A. paradoxum*, Dalm., from Sierra Leone, closely allied to the insect which is used in caprification.]

Eurytoma, Illig., has the male antennæ nodose and verticillated, and the ovipositor short. [Numerous small British species.

Miscocampus, Latr. [*Torymus*, Dalm., or more properly *Callimome*, Spinola], has the antennæ not verticillated, and the ovipositor long. One species is parasitic upon the Cynips of the Rose bedeguar, [a very numerous British genus].

The others have the abdomen flat above, triangular and pointed in the females, or subcordate or suborbicular. The ovipositor is mostly concealed.

In some of these, the stigmal branch arises at a distance from the union of the costal nerve with the costa of the fore wings.

Perilampus, Latr., has the abdomen short and cordate, and not prolonged, with the scutellum thick and prominent. [Several British species.]

Pteromalus, Latr., has the thorax short, with the collar not narrowed in front, and the abdomen of the females terminated in a conical point. [A very numerous genus.]

Cleonymus, Latr., has the collar elongated and narrowed in front; the abdomen is also much longer. [*C. depressus*, Latr., a rare British species, &c.]

In others, the stigmal branch arises from the union of the costal nerve with the costa; the middle legs are longest, with a long spur at the apex of the tibiæ.

Eupelmus, Dalm. [has the ovipositor exserted], and the basal joint of the middle tarsi broad and ciliated, and the stigmal branch removed from the costal nerve.

Encyrtus, Latr., has the stigmal branch arising from the apex of the costal nerve; the club of the antennæ is compressed and truncate. [A very numerous genus, of minute species.]

Spalangia, Latr., differs from all the preceding in having the antennæ inserted quite close to the mouth.

Eulophus, Geof. (*Entedon*, Dalm.), has the antennæ from 4- to 8-jointed, those of [some] males being branched. [A very extensive genus.]

[This family, *Chalcididæ*, has recently received much attention, and a great number of additional genera have been established, especially by Spinola, Dalman, Walker, Esenbeck, Haliday, and myself. Those found in this country are described in the generic synopsis of my "Modern Classification."]

The fifth tribe, OXYURI, resembles the preceding in the absence of nerves in the lower wings, but the abdomen of the females is terminated by a tubular ovipositor of a conical form, and either internal, exsertile from the anus like a sting, or external, and forming a kind of tail or terminal point. The antennæ are from 10- to 15-jointed, and either filiform or rather thickened to the tips, or clavate in the females. The maxillary palpi in many are long and pendent. We reunite the different genera of which it is composed to that of

BETHYLUS, Latr. & Fabr.

Their habits are probably the same as those of the Chalcidites, but as the majority of these insects are found upon the ground or low plants, I conjecture that their larvæ live in the earth.

Some have the wings furnished with veins and cells, and a portion of these have the antennæ inserted near the mouth.

Dryinus, Latr. (*Gonatopus*, Klug), has the antennæ straight, 10-jointed, in both sexes; the thorax binodose, and the fore tarsi terminated [in the females only] by two large reflexed hooks. Some females are apterous. [See the monographs of Esenbeck and Walker.]

Anteon, Jur., has only 10-jointed antennæ, at least in the males, but the thorax is continuous, and the tarsi are terminated [in the males only] by ordinary-sized claws,

Bethyllus, Latr. (*Omalus*, Jur.), has the antennæ elbowed, 13-jointed, in both sexes, the head flattened, and the prothorax elongated and subtriangular.

Another portion has the antennæ 13- to 15-jointed, and inserted near the middle of the face.

Proctotrupes, Latr. (*Codrus*, Jur.), have them 13-jointed and straight in both sexes. [Numerous British species, monographed by Haliday.]

Helorus, has the antennæ distinctly elbowed, and 15-jointed; the first joint of the abdomen forms a sudden long peduncle. [*H. anomalipes*, a singular British insect.]

Belyta and *Cinetus*, Jur., have the antennæ 14- or 15-jointed, filiform in the males, and thicker at the tip in the females.

The other Oxyuri have neither cells nor brachial or basal nerves. Some of these have the antennæ inserted in the forehead. These are

Diapria, Latr. (*Psilus*, Jur.), which has no cell in the wings. The males have 14-, and the females 15-jointed antennæ.

Others have the antennæ inserted near the mouth.

Ceraphron, Jur., has a radial cell, the maxillary palpi prominent, the antennæ filiform and 11-jointed, and the abdomen ovate-conic.

Sparasion, Latr., is similar to Ceraphron in the radial cell and maxillary palpi, but with the antennæ 12-jointed in both sexes.

The two following subgenera differ from Sparasion in having the palpi very short, and not exserted or pendent.

Teleas, Latr. having 12-jointed antennæ.

Scelio, Latr., with 10-jointed antennæ.

In the terminal subgenus *Platygaster*, Latr., the radial cell is wanting, the antennæ in both sexes are 10-jointed, the first and third being very elongated; the palpi are very short, and the abdomen spatulate. I refer to this subgenus the *Psilus Boscii*, Jurine, a very curious insect, in which the basal segment of the abdomen supports a strong horn, which extends over the back of the head and thorax, and which, according to Leclerc de Laval, is a tube for the ovipositor. [This opinion is certainly incorrect. The insect is remarkable for its habits, and has been described by the Canon Schmidberger, under the name of the Paradoxical Pear-fly. See Kollar, *Obnox. Ins.*, translated by Miss Loudon.] The species is very minute, and black.

[See the monographs of Platygaster, and several of the preceding genera, published by Mr. Walker in the *Entomological Magazine*, in which work, as well as in Esenbeck's work on these families, various additional genera are described.]

The sixth tribe, CHRYSIDES, Latr., like the three preceding tribes, have the hind wings not veined, but the ovipositor is formed by the terminal segments of the abdomen, like the sliding tubes of a telescope, and terminated by a small sting. The abdomen, which in the female appears to be formed of only three or four segments, is vaulted or flattened beneath, and capable of being folded against the breast, when the insect assumes the appearance of a ball. This tribe is composed of the genus

CHRYSIS, Linn.,—

Which in the richness of their colours vie with the Humming-birds; hence they have been termed Golden-tailed Flies. They may be observed walking, but in a constant agitation and with great agility, upon walls and palings exposed to the heat of the sun. They are also found upon flowers. The body is elongated, and covered with a solid skin; the antennæ filiform, elbowed, and vibratile; the maxillary palpi long and 5-jointed, the labial 3-jointed; the abdomen in the majority is semi-oval, truncated at the base, so as to appear sessile; the terminal segment has often a deep row of impressed dots, and the apex is denticulated. They deposit their eggs in the nests of Solitary Mason-bees, or other Hymenoptera, their larvæ destroying those of these insects.

Parnopes, differs from the rest in having the maxillæ and lower lip very long, forming a proboscis. *P. carnea*, a continental species, places its eggs in the nest of *Bembex rostrata.*

The others have not an elongated proboscis.

In some the thorax is not narrowed in front, the antennæ semi-ovate, and only with three segments, as in *Chrysis* proper, which may be thus divided :—

Those with the four palpi equal, and the labium deeply notched, form the genus *Stilbum*, Spin., to which we may unite *Euchræus*, Latr.,—[and *Pyria*, St. Fargeau]. Those with the maxillary palpi much longer than the labial, with the labium notched, and the abdomen rounded at the tip, form the genus *Hedychrum*. Those with the palpi as in Hedychrum, but with the labium rounded and entire, form the genera *Elampus* and *Chrysis*, the first of which has the mandibles with two teeth within, and the abdomen entire at the tip, and the second has the mandibles with one tooth within, and the extremity of the abdomen is spined, and has a row of deep spots. To this last group belongs *C. ignita*, Linn., the commonest species in Europe, of a blue colour, with the abdomen fiery-red.

Cleptes, Latr., has the mandibles short and toothed, and the thorax narrowed in front; the male has the abdomen 5-, and the female 4-jointed.

[See the monograph of British Chrysides published by Shuckard in the *Entomological Magazine*, and the more recent one of Klug, and Spinola's memoir in the French *Entomological Society's Transactions*, as well as Saint Fargeau's, in the *Mémoires du Muséum*.

The second section of the Hymenoptera, the ACULEATA, differs from the first in wanting a borer; a sting, composed of three pieces, which is concealed and retractile within the abdomen, ordinarily replaces it in the females and in the neuters of such species as are united in societies. Sometimes, as in some Ants, this sting does not exist, and the insect defends itself by ejecting an acid liquid secreted in special reservoirs under the form of glands.

The Hymenoptera of this section have always the antennæ simple, and composed of a constant number of joints, namely, thirteen in the males and twelve in the females; the palpi are ordinarily filiform; the maxillary palpi often longer, have six joints, and the labial four. The mandibles are smaller, and often more toothed in the males than in the other individuals. The abdomen, united to the thorax by a peduncle, or slender thread, is composed of seven joints in the males and six in the females. The four wings are always veined, and offer the different sorts of ordinary cells.

The larvæ have never any feet, and subsist upon food which the females or neuters provide them with, consisting either of the dead bodies of insects, or the honey of flowers; and in some species of a mixture of pollen, stamens, and honey.

This section is divided into four families, [*Heterogyna, Fossores, Diploptera,* and *Anthophila*].

THE FIRST FAMILY OF THE ACULEATED HYMENOPTERA,

THE HETEROGYNA—

Is composed of two or three kinds of individuals, of which the most common, or the neuters, or females, have no wings, and rarely ocelli distinct. All of them have the antennæ elbowed, and the lower lip small, rounded, and vaulted or spoon-like.

Some of these live in society, and present three kinds of individuals, of which the males and females are winged, and the neuters wingless; in the last two kind of individuals the antennæ are thickened to the tips, and the length of the basal joint is at least equal to one-third of their entire length; the second is nearly as long as the third, and in the form of a reversed cone. The upper lip of the neuters is horny, and shuts perpendicularly beneath the mandibles. These Hymenoptera compose the genus

FORMICA, Linn. (or the Ants),—

So celebrated for their foresight, and of which some are so well known for the injury they commit in our gardens and the interior of our houses, where they attack saccharine matters, preserved viands, &c., giving them a disagreeable scent of musk; whilst others are equally obnoxious to trees, by gnawing the interior, in order to make for themselves a habitation where they may breed.

The Ants have the peduncle of the abdomen like a scale or knot, either single or double, whereby they are easily distinguished. They have the antennæ elbowed, generally rather thicker at the tips; the head triangular, with the eyes oval or rounded, and entire; the clypeus large; the jaws very strong in a great number, but of which the form varies in the neuters; the maxillæ and labium are small · the palpi filiform, those of the maxillæ being longest; the thorax compressed at the sides, and the abdomen nearly oval, furnished in the females and workers either with a sting or with glands situated near the anus, which secrete a peculiar acid, called formic acid.

They live in society, often of great extent, each species consisting of males and females, which have wings which are much less veined than in the majority of this section, and which easily fall off; as well as of neuters, which are destitute of wings, and which are only females with the ovaries imperfect. The two former kind of individuals are only found temporarily in the Ants' nest, from which they make their escape almost as soon as they have gained their wings. The males are much smaller in size than the females, as are also their heads and mandibles, and the eyes larger. The union of the

sexes takes place in the air, where the winged individuals form large swarms, after which the males soon die, without again entering their former abode. The females, now ready to become mothers, quit the neighbourhood, and, having first pulled off their wings with their feet, become the foundresses of new and distant colonies. Some are, however, made prisoners by the neuters of the parent colony, who strip them of their wings, in order that they may deposit their eggs, after which it is believed that they are driven off.

The neuters, distinct not only by their want of wings and ocelli, but also by the size of the head, the strength of the jaws, the thorax more compressed and often nodose, and the legs proportionably longer, are alone charged with the works of the nest and rearing of the young, the nature and form of the former of which varies according to the instinct of the different species. They are more generally established in the ground, some using only particles of earth, and having their nests entirely hidden, and others covering their nests with bits of stick, straws, &c., forming a conical mound. Some inhabit the trunks of old trees, which they pierce in every direction. The neuters feed the young grubs, and move them on fine days to the outer surface of the nest, in order to give them heat, and removing them back again at the approach of night or bad weather; they defend them from their enemies, and take the greatest care of them and of the pupæ, especially when the nests are disturbed. Some of the latter are inclosed in a cocoon, whilst others are naked: the neuters also tear open the cocoon when the period of the final change arrives.

Different nests have exhibited to me neuter individuals (few in number) remarkable for having a much larger head than the ordinary neuters; M. Lacordaire also gave me a neuter Ant allied to *Atta cephalotes*, Fab., assuring me that the individuals of this kind are the defenders of the society, and appear to perform the duty of captains in their excursions.

The name of Ant-eggs is commonly given to the larvæ and pupæ. Those of *T. flava* are used for feeding young Pheasants. The neuters prevent the perfect insects, which have recently acquired their wings, from leaving the nest until a favourable opportunity, dependent upon the heat of the atmosphere.

The majority of Ants' nests are entirely composed of a single species, but Nature has departed from this plan in *F. (Polyergus) rufescens*, or the Amazon Ant, and *F. sanguinea*. The neuters of these two species seize by violence auxiliaries or slaves of their own *caste* (neuters), but of different species, namely, *F. cunicularia*, Latr., and *F. fusca*, Linn. When the heat of the day begins to decline, and regularly at the same hour, at least during several days, the Amazon Ants quit their own nests in a close and numerous column, and direct their course to the ant-hill they intend to attack, and which they enter, in spite of the opposition of the owners, and carry off in their jaws the larvæ and pupæ of the neuters of these Ants, and which they take to their own nest, where they are tended by other neuter slave Ants of the same species, which have been previously stolen in a similar manner, and which also take charge of the young of these amazon conquerors. Such is the composition of a mixed Ant-nest.

It is known that Ants are very fond of the saccharine liquid which exudes from the bodies of *Aphides* and *Coccidæ;* four or five species also collect the Aphides, and even their eggs, which they keep at the bottom of their nests, especially in bad seasons. Others construct galleries of earth from their nests along the stems of branches of trees, as far as the twigs peopled by the Plant-lice.

The winged Ants perish at the commencement of the cold weather, but the neuters pass the winter dormant in their nests; their prudence, so much celebrated, has no other end than to augment and consolidate their habitation with all kinds of matters; for a store of food would be useless in a season when the insects could not use it.

The habits of exotic, and especially tropical Ants, are almost unknown. The Visiting Ant performs some service to our colonists by driving away Rats, and a quantity of other obnoxious insects; but other species are obnoxious from the destruction which they make, and which it is impossible to prevent.

I divide the genus Formica in the following manner:—

1. *Formica* proper, destitute of a sting; the antennæ inserted near the forehead; mandibles triangular and denticulated; the abdominal peduncle consists of a single knot. *Formica rufa*, Linn. [the great Horse Ant, or Pismire], common in woods, where it forms nests like a large sugar loaf or dome, composed of earth, fragments of wood, &c., and which are often of large size; the winged individuals appear in spring. *F. fusca, cunicularia*, and a great number of species.

2. *Polyergus*, Latr., which is also destitute of a sting, but with the antennæ inserted near the mouth, and the mandibles narrow, curved, or very much hooked. *P. rufescens*, the Amazon Ant above described, not yet discovered in this country.

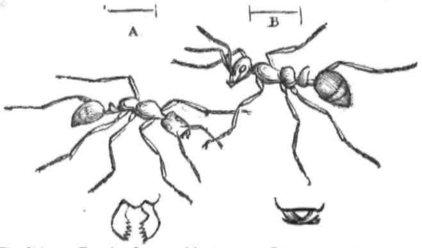

Fig. 119.—A Formica fusca and its jaws; B, Polyergus rufescens and its jaws.

3. *Ponera*, Latr., the neuters and females armed with a sting. Peduncle of abdomen formed of a single knot, antennæ in these individuals thickened at the tip; mandibles triangular; head subtriangular. *P. contracta*, Latr., a very small species, [first discovered in England by me].

Odontomachus, Latr., has the peduncular node spined above; the antennæ of the neuters filiform; the head oblong, and deeply emarginate behind; and the mandibles long and narrow; all the species are exotic.

4. *Myrmica*, Latr., has also a sting, but the peduncle of the abdomen is composed of two knots; the antennæ exposed; the maxillary palpi long and 6-jointed; and the mandibles triangular. *F. rubra* [misprinted *rufa* by Latreille], Linn., a very common British species.

Eciton, Latr., differs from Myrmica only in having linear mandibles.

Atta, Fabr., differs from Myrmica only in having very short palpi; the head of the workers is generally very thick. *A. cephalotes*, Fab., the Visiting Ant of the West Indies, above mentioned.

Cryptocerus, Latr., furnished with a sting, with the peduncle of the abdomen formed of two knots; the head very large and flat, with a groove on each side to receive the antennæ. South American insects, [monographed by Klug]. [The excellent monograph of the ants by Latreille, and, as relates to their habits, the memoirs of Huber, ought to be consulted in this family.]

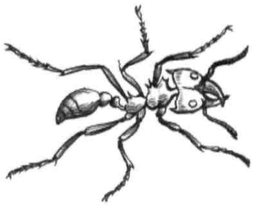
Fig. 120.—Atta cephalotes.

The other *Heterogyna* are solitary in their habits, each species being only composed of winged males and apterous females, the latter always armed with a powerful sting; the antennæ are filiform or setaceous, vibratile, with the first and third joints elongated; the length of the first never equalling one third of these organs. They form the genus

MUTILLA, Linn.

Some, of which males have only been observed, have the antennæ inserted near the mouth; the head small, and the abdomen long and nearly cylindric. Genera, *Dorylus*, from Africa and India, and *Labidus*, from South America, [to which must be added two others, described by Mr. Shuckard in his monograph on these genera, published in the *Annals of Natural History*, May and June, 1840].

The others have the antennæ inserted near the middle of the face; the head is more robust than in the preceding, and the abdomen either conic or ovoid. These form the genus Mutilla proper, the species of which are found in hot sandy districts. The females run quickly, and always on the ground. The males often alight upon flowers, but we are ignorant of their precise economy.

Some have the thorax nearly cubical, and not nodose in the females.

Apterogyna, Latr., has the two basal segments of the abdomen in the form of knots; the male antennæ are very long; the fore-wings have only basal cells, and a single cubital small and rhomboidal cell. [Exotic insects.]

Psammotherma, Latr., has three cubital cells, with two recurrent nervures; and the males have the antennæ pectinated. [*Mutilla flabellata*, Fabr., Cape of Good Hope.]

Mutilla proper, has also three cubital cells, with two recurrent nerves, but the antennæ are simple in both sexes, and the second segment of the abdomen does not form a knot. Type, *Mutilla europæa*, [a rather common British species].

Myrmosa, Latr., differs from the preceding in having the thorax in both sexes equal, but divided into two distinct segments, with the abdomen conic in the females.

Myrmecoda, Latr., has the thorax of the females also equal above, but divided into three segments by sutures, and the maxillary palpi very short. [These insects are now proved to be the females of the genus *Thynnus*, placed by Latreille in the family Scolietes.]

Scleroderma, Klug, differs only in the maxillary palpi being elongated, and the antennæ has the second joint not inclosed in the tip of the preceding. [Small continental species. See my monograph on this genus, published in the *Transactions of the Entomol. Soc. of London*, vol. ii.]

Methoca, Latr., has the thorax nodose. [*M. ichneumonides*, a very interesting insect, found but rarely in this country, resembling an Ant, and now proved to be the female of the genus Tengyra, placed by Latreille in the next family.]

THE SECOND FAMILY OF THE ACULEATED HYMENOPTERA,—

THE FOSSORES,—

Comprises those aculeate Hymenoptera which have all the individuals winged, and of two kinds only [males and females], and which live solitarily, their legs being fitted only for walking, and in many for

digging; the labium is always more or less notched at the tip, and never filiform or setaceous; the wings are always extended. They compose the genus

SPHEX, Linn.,—

The majority of the females of which deposit with their eggs, in nests formed for their reception, in earth or wood, various insects or their larvæ, and sometimes Spiders, which they have previously pierced with their stings, and which serve for the food of their young, when hatched; the latter resemble worms, having no feet, and are transformed in a cocoon which they have spun previous to becoming pupæ; the perfect insect is generally very active, and lives upon flowers; the maxillæ and labium are elongated and proboscis-like in many species.

We distribute the numerous subgenera separated from the primitive genus Sphex, into seven principal groups [*Scolietes, Sapygites, Sphegites, Bembecides, Larrates, Nyssoniens, Crabronites*]. In the two first of these, the eyes are often notched; the body of the males narrow, long, and terminated by three anal points, or teeth.

1. The *Scolietes*, comprising those which have the first segment of the thorax sometimes arched, and extended at the sides as far as the wings, sometimes transverse-quadrate, or like a knot; the legs short, thick, very spinose, with the tibiæ curved near the base, and the antennæ of the females shorter than the head and thorax. They are named after the genus

SCOLIA, Fab.

Some have the maxillary palpi long, with unequal-sized joints, and the basal joint of the antennæ sub-conical. Such are

Tiphia, Fab., with which we may associate *Tengyra*, Latr.

The others have the maxillary palpi short, and the basal joint of the antennæ long.

Myzine, Latr. (with the mandibles dentate), and

Meria, Latr. (with the mandibles simple), have the basal joint receiving and hiding the second.

Scolia, proper, has the second joint of the antennæ exposed. [This is a numerous genus, composed for the most part of large exotic species.]

2. The *Sapygites*, Latr., have the first segment of the thorax formed as in the preceding, with the legs short but slender, neither spined nor strongly ciliated, and the antennæ in both sexes as long as the head and thorax; the body is generally naked. This subdivision is named after the principal genus

SAPYGA, Latr.

Some have filiform or setaceous antennæ.

Thynnus, Fab., has the eyes entire, [New Holland insects]; and *Scotæna*, Klug [Brazilian species].

Polochrum, Spin., has them notched, and the mandibles toothed.

Others have the antennæ thickened at the tips, or clavate in some males.

Sapyga proper, the species of which fly about walls and trees exposed to the sun, on which they appear to deposit their eggs. [It now appears that they are parasites in the nests of Bees which inhabit those situations].

Ceramius, Latr., from the form of the prothoracic collar and the extended wings, belongs to this subdivision; but from more important characters it ought naturally to be united with the Diploptera.

3. The *Sphegites* are Fossores, which nearly approach the preceding in respect to the prothoracic collar, but the hind legs are at least as long again as the head and thorax, and the antennæ are often slender, formed of loose joints, and much curved in the females. They are named after the dominant genus

SPHEX.

Some have the first segment of the thorax square, either transverse or longitudinal, and the abdomen attached to the thorax by a very short peduncle; the upper wings have generally two or three complete cubital cells, and another imperfect and terminal. They now form several subgenera.

Pepsis, Fab., has the labrum apparent; the antennæ in the males straight; the maxillary palpi not much longer than the labial; the males have the hind tibiæ and tarsi compressed. All the species are exotic, especially South American, and have the wings coloured.

Ceropales, Latr., has the labrum and antennæ of Pepsis, but the maxillary palpi are much longer, with very unequal-sized joints.

Pompilus, Fab., resembles Ceropales in the latter respect, but the antennæ of both sexes are convoluted and composed of loose joints; the labrum is but slightly exposed. Type, *S. viatica*, Linn. [a common species]. These insects provision their nests with Spiders, having first pricked them with their stings.

Salius, Fab., is established upon the males of some species which have the pro- and metathorax proportionably more elongated than in Pompilus, and the mandibles are not toothed.

Planiceps, Latr., differ from Salius in having the head flat, with the posterior margin concave, the ocelli very

small and distant; the fore-wings have only two complete cubital cells, the second of which receives the first recurrent nerve.

Aporus, Spinola, has also two complete cubital cells, but the second receives the two recurrent nerves; in other respects they entirely resemble Pompilus.

The others have the first segment of the thorax narrowed in front like a knot, and the first abdominal segment, and sometimes part of the second, narrowed into an elongated peduncle; the upper wings have always three perfect cubital cells, and the commencement of a fourth.

Fig. 121.—Ammophila sabulosa.

Ammophila, Kirby, has the mandibles dentate, and the maxillæ and labium very long and proboscis-like; the second cubital cell receives the two recurrent nerves. Type, *Sphex sabulosa*, Linn. [a very common British species], the female of which provisions her nest with caterpillars.

Miscus, Jur. (Fam. 1), differs only in having the third cubital cell petiolated in front.

Others have the mandibles and palpi similarly formed, but the maxillæ and labrum are much shorter.

In *Pronæus*, Latr., the second cubital cell receives, as in Ammophila, the two recurrent nervures. [A large African species].

In *Sphex* proper the same cell receives only the first recurrent nerve; the third is inserted beneath the other. [*S. flavipennis*, the only British species, but very rare.]

In *Chlorion*, Latr., the first recurrent nerve is inserted beneath the first cubital, and the second beneath the third. *C. compressum*, a splendid green species with red thighs, which is very common in the Isle of France, where it provisions its nest with Blattæ.

Dolichurus, Latr., has the maxillary palpi much longer than the labial, and nearly thread-like.

The last Fossores of this third division have no teeth to the mandibles.

Ampulex, Jur., resembles Chlorion in the insertion of the recurrent nerves.

In the two following the second cubital cell receives the two nerves.

Podium, Latr., has the maxillary palpi scarcely longer than the labial. [Exotic species.]

Pelopæus, Latr., has them longer, with unequal joints; the antennæ are inserted higher. *P. spirifex*, a continental species, makes its nests of mud in the angles of rooms, arranging them spirally, covering them with mud, and provisioning them with Spiders, dipterous insects, &c.

4. The *Bembecides* have the collar linearly transverse, the sides not extending to the base of the wings; the legs short, or of moderate length; the abdomen semiconical and elongate; the labrum naked and exserted. This family is named after the genus

BEMBEX, Fabricius,—

The species of which are peculiar to warm climates. The body is elongated, pointed behind, mostly varied with black and yellow, or reddish and glabrous; the mandibles narrow, elongated, toothed inside, and crossing each other; the fore-tarsi of the females furnished with spinose ciliæ; the males have generally one or two elevated teeth on the under-side of the abdomen. The species are rapid in their flight, and make a sharp buzzing noise; many emit a strong scent of roses.

Some have the proboscis long, and the labrum forms a long triangle.

Bembex proper has very short palpi. *B. rostrata*, Linn. [a reputed British species], forms deep burrows in the sand [for its nest], which it provisions with two-winged flies, as Syrphidæ, Muscidæ, &c.

Monedula, Latr., has the palpi long. [Exotic species.]

Stizus, Jur., has the proboscis not elongated, and the labrum short and rounded. [Exotic species.]

5. The *Larrates* have the appearance of the Bembecides, but the labrum is concealed, and the mandibles have a deep notch within at the base.

Some have three complete cubital cells.

Palarus, Latr. (*Gonius*, Jur.), has short antennæ thickened at the tips, and the second cubital cell is petiolated. [A continental species].

Lyrops, Ill., has filiform antennæ, and the mandibles have a tooth within.

Larra, Fab., differs from Lyrops in the mandibles not having a tooth within.

The others have only two complete cubital cells.

Dinetus, Jur., has both cubital cells sessile, and the mandibles 3-dentate within.

Miscophus, Jur., has the second cubital cell petiolated, and the inside of the mandibles not toothed.

6. The *Nyssoniens* have the labrum more or less completely hidden, the maxillæ and labium not forming a proboscis; the mandibles without a notch at the base within; the head of ordinary size, and the abdomen gradually attenuated and never peduncled.

Astata, Latr. (*Dimorpha*, Jur.), has three complete sessile cubital cells, and the radial is appendiculated; the eyes are contiguous, [especially in the males].

Nysson, Latr., has the same number of cubital cells, but the second is petiolated; the radial is not appendiculated, and the eyes are wide apart.

Oxybelus, Latr., has only one complete cubital cell, receiving a single recurrent nerve; the mandibles terminate in a simple point, and the scutellum is spined.

Nitela, Latr., has also only a single cubital cell, the mandibles terminate in teeth, and the scutellum is not spined.

Pison, Jur., differs from all the rest in having the eyes emarginate.

7. The last division of the Fossores, that of the *Crabronides*, differs from the preceding only in having the head generally larger and nearly square, the antennæ often thickened at the tip, the abdomen oval or elliptic, with the base narrower than the middle, and often pedunculated.

Some have the antennæ inserted below the middle of the face, with the clypeus short and wide.

Trypoxylon, Latr. (*Apius*, Jur.), differs from the rest in having the eyes notched. *T. figulus*, [a very common British species, having the abdomen long and slender at the base]. The female makes use of burrows formed by other insects, in order to deposit her own insects therein, together with spiders for their support, closing the hole with fine earth.

Of those with entire eyes, some have the mandibles narrow, and mostly terminated by a point, and the antennæ close together at the base.

Gorytes, Latr. (*Arpactus*, Jur.), has three complete submarginal cells; the mandibles of moderate size, and unidentate within; the anterior tarsi are often ciliated. [See the monograph of Saint Fargeau in the *Annal. Soc. Entomol. de France*.]

Crabro, Fab., has only a single closed cubital cell; the mandibles terminate in a bifid point; the antennæ elbowed, filiform; the clypeus often glitters with silver or golden hairs. Some males are remarkable for the great dilatation of the anterior tibiæ and basal joint of the tarsi. The female of *C. cribrarius* provisions its nest with the larvæ of a Tortrix found in the oak. Others employ dipterous insects for the same purpose. [See the monograph of Saint Fargeau and Brullé in the same *Annales*.]

Stigmus, Jur., is so named from the great size of the stigma of the fore wings, which have two closed cubital cells.

In others the mandibles, at least in the females, are stronger, and bidentate within, and the antennæ are wide apart at the base.

Pemphredon, Latr., has two complete cubital cells, and a third commenced. One species, *P. unicolor*, feeds its larva with plant lice.

Mellinus, Fabr., has three complete sessile cubital cells, and often the commencement of a fourth, not extending to the tip of the wing.

Alyson, Jur., have also three complete cubital cells, but the second is petiolated.

The terminal Crabronites have the antennæ inserted nearer the middle of the face, and thickened at the tips.

Psen, Latr., has the clypeus nearly square, and the abdomen peduncled.

Philanthus, Fabr., has the clypeus trilobed; the basal segment of the abdomen is narrowed into a knot; the antennæ suddenly thickened, [and the abdominal segments not constricted], and all the cubital cells sessile.

Cerceris, Latr. (*Philanthus*, Jur.), has the antennæ gradually thickened, [the abdominal segments constricted], and the second cubital cell peduncled.

The females of these insects make their nests in the sand, burying the dead bodies of Bees, Andrenæ, and Weevils, as food for their progeny.

Trachypus, Klug, scarcely differs from the last.

[The British species of Fossorial Hymenoptera have been monographed by Mr. Shuckard, in a volume published upon that tribe. Van der Linden and Klug have also especially studied these insects].

THE THIRD FAMILY OF THE ACULEATED HYMENOPTERA,—

THE DIPLOPTERA,—

Is the only one in this section which (with very few exceptions, *Ceramius*) has the fore-wings folded longitudinally; the antennæ are ordinarily elbowed and clavate, and thickened at the tips; the eyes are notched; the collar extends at the sides as far as the wings; the fore-wings have two or three complete cubital cells, the second of which receives two recurrent nerves: the body is glabrous and black, more or less varied with yellow or fulvous. Many live in temporary societies, composed of males, females, and neuters. The females which have withstood the severity of the winter, commence the nest and take care of the young which they produce; they are subsequently assisted by the neuters.

We divide the Diploptera into two tribes, [*Masarides* and *Vespariæ*].

The first, or the MASARIDES, have the antennæ at first sight only composed of eight joints, the eighth forming with the following a nearly solid mass, with indistinct articulations; the upper wings

have only two complete cubital cells; the middle and tne fore margin of the clypeus is emarginate, receiving the labrum in the emargination. The tribe is named after the typical genus,

MASARIS, Fabricius.

Masaris proper, has the antennæ rather longer than the head and thorax, and the abdomen long.

Celonites, Latr., has the antennæ scarcely longer than the head, and the abdomen scarcely longer than the thorax.

The second tribe of the Diploptera, that of the VESPARIÆ, is composed of the genus

VESPA, Linn.,—

The antennæ of which are distinctly 13-jointed in the males, 12-jointed in the females, and terminated by an elongated mass, which is pointed and sometimes hooked at the tip (in the males); they are always elbowed, at least in the females and neuters. The lower lip is sometimes divided into four plumose filaments, and sometimes into three lobes, with four glandular points at the tip, the middle lobe being notched at the tip. If we except a very few species, the upper wings have three complete cubital cells. The females and neuters are armed with a powerful sting. Many live in societies, consisting of males, females, and neuters.

The larvæ are vermiform, without feet, and each is inclosed in a cell, where they feed either upon the dead bodies of insects which the parent Wasp had deposited at the same time as the egg, or upon the honey of flowers, the juice of fruits, or of animal matters, elaborated in the stomach of the females or neuters, and which these individuals feed them with daily. M. Saint Hilaire discovered a species in Brazil which makes an abundant provision of honey, which, like common honey, is under some circumstances poisonous. (*Mém. du Mus. Hist. Nat.*)

Ceramius, Latr., has the fore wings extended and flat, and only two cubital cells. [Exotic species, one of which, *C. lusitanicus*, appears to be allied to Masaris.] In all the rest the fore wings are doubled [longitudi nally when at rest], and have three complete cubital cells.

Some have the mandibles longer than broad, and beak-like; the labium is narrow and elongate, with the clypeus cordate or oval.

These are solitary Wasps, each species consisting of males and females, which last lay up a store of provisions for their young before they are born, and for the whole period of their larva state. Their nests are formed of earth, sometimes concealed in holes in walls, in the earth, or old wood, and sometimes they are fixed upon plants, the parents storing them with caterpillars or spiders, having previously wounded them with their stings.

Synagris, Latr., has the labium divided into four long plumose filaments, without glandular points at the apex. [*S. cornuta*, and other African species.]

Eumenes, Latr., has the labium divided into three pieces; the middle one bifid, and all glandular at the tips.

In some of these the abdomen is ovoid, or conic, and thick at the base, as in

Pterochilus, Klug, having an elongated proboscis. (*Pt. phalerata*, a German species).

Odynerus, Latr. (and *Ryggchium*, Spin.), in which the lower parts of the mouth are short. The female of *V. muraria* forms burrows in the sand several inches deep, at the mouth of which she constructs a curved earthy tube; she provisions her nest with six or eight green larvæ without feet, and with them deposits an egg, and then closes the mouth of the cell, and destroys the tube. [There are numerous British species.]

In the others the abdomen has the basal joint narrow, long, and pear-shaped, and the second bell-shaped.

Eumenes proper (*E. coarctata*, Fab.), the typical species, constructs its spherical nest upon the stems of plants, especially heath, in which it deposits an egg, together with a supply of honey, according to Geoffroy.

In *Eumenes* the mandibles form a long and pointed beak; in *Zethus* they are shorter, and the maxillary palpi not longer than the maxillæ. In *Discœlius*, which resembles Zethus in the mandibles, the maxillary palpi are longer.

The remaining species of Wasps have the mandibles scarcely longer than broad, with a broad and oblique truncation at the tip; the labrum is short, and the clypeus nearly square. They form the genus

Vespa proper (and *Polistes*, Latr.), and are united in societies, often very numerous, composed of males, females, and neuters. The two latter kinds of individuals form, with bits of old wood or bark, and which they detach with their jaws and reduce to a pulp-like paper, horizontal layers of hexagonal cells, like honey-comb, suspended from above by several short pillars and opening downwards, and which are solely used to lodge, in an isolated manner, the larvæ and pupæ. The number of these layers in a Wasp's nest varies. The nest is sometimes open and sometimes enveloped in a covering, with apertures leading to the cells. Its figure is varied in the different species.

The females commence the nest [in the spring], and deposit eggs, which produce neuters, or workers, which assist in enlarging the nest, and tending the subsequent broods, until the beginning of autumn. The society consists only of these two kinds of individuals; at that period, however, the young males and females appear, all the larvæ and pupæ which do not undergo their final change before November are destroyed by the neuters, which likewise perish, as well as the males, with the cold; a few females alone remain, to become the foundresses of fresh colonies in the following spring. Wasps feed upon other insects, meat, fruit, and feed their young with the juices

of those substances. The larvæ, owing to the position of their cells, have the head downwards; and, when ready to become pupæ, spin a cocoon for themselves. The males neither work [nor sting.]

Some species (forming the genus *Polistes*, Latr.), have the portion of the inner edge of the mandibles which is beyond the angle shorter than that which precedes this angle, and the middle of the clypeus is pointed. Some of these, as the Brazilian *P. morio*, have the abdomen formed as in Eumenes, whilst in others, as in the French *P. gallica*, Linn., it is of an oval form. The former of these two species makes a large inclosed nest in the form of a truncated cone, with a hole at the bottom, [fixed to the branches of trees]; the second makes its nest, consisting of about twenty or thirty cells, exposed and arranged like a bouquet, the outer cells being smallest. Others have the abdomen ovoid, or conical, as in the South American *V. nidulans*, which suspends its nests to the boughs of trees by a ring, the nests being of a conical form, with a convex bottom, having an opening in it. In proportion to the extent of the community the nest is enlarged, by a fresh layer of cells being added to the under-side of the old bottom.

The other Wasps, forming the genus *Vespa* proper, have the upper portion of the inner edge of each mandible as long as, or longer than, the posterior, which precedes it, and the middle of the front edge of the clypeus is truncate, with a tooth on each side. *Vespa crabro*, the Hornet; *V. vulgaris*, the common Wasp, and other species.

THE FOURTH FAMILY OF THE ACULEATED HYMENOPTERA,—

THE MELLIFERA, or ANTHOPHILA, Latr. (the Bees),—

Exhibits, in the peculiar circumstances of the two hind feet, that of collecting the pollen of flowers, an unique character, which distinguishes it from all the other families of insects. The first joint of the tarsi in these feet is very large, much compressed, in the form of a square plate, or of a reversed triangle. The parasitic species are, however, destitute of this peculiar property; but the form of their feet is always essentially the same; they are merely deprived of hairs, or pollen brushes.

The maxillæ [and lower lips] are generally very long, and form a kind of proboscis; the lower lip has often the form of a lance-head, or a long filament, the extremity of which is silken or hairy. Their larvæ feed exclusively on honey, and the fecundating farina of flowers; the perfect insect, in like manner, only subsists on honey. These Hymenoptera embrace the genus *Apis*, Linn., which I divide into two sections, [*Andrenetæ* and *Apiariæ*].

The first section, ANDRENETÆ, Latr., has the middle division of the lower lip in form of a heart, or lance-head, shorter than its sheath and folded above in some, and nearly straight in others. It is composed of the genus

ANDRENA, Fab. (*Proabeille*, Réaumur; *Melitta*, Kirby].

These insects live solitarily, and only possess two kinds of individuals, males and females. The mandibles are simple, or terminated by not more than two teeth; the labial palpi resemble the maxillary, which are always 6-jointed; the lateral lobes of the labium are very short. The majority of the females collect upon the hairs of the hind-feet the farina of flowers, and form it, with a little honey, into a kind of paste, for the food of their larvæ. Thay form in the earth, and often in beaten foot-paths, deep burrows, in which they place this paste, with an egg, and then close the aperture with earth.

Some have the middle division of the lower lip heart-shaped, and folded in repose.

Hylæus, Fab. (*Prosopis*, Jur.), has the body glabrous, the upper wings with only two complete submarginal cells. They do not gather pollen, and appear to deposit their eggs in the nests of other Bees. [Several British species.]

Colletes, Latr., has the body villose, with three complete cubital cells; these collect pollen. Type, *A. succincta*, Latr. [a common British species].

The others have the labium in the form of a lance-head, and some of them have this part folded upon the upper side of the sheath, as in

Andrena, [having the hind feet not remarkably pilose, consisting of very numerous British species], and

Dasypoda, the last of which has the hind tarsi clothed with very long hairs. The upper wings in both these subgenera have only two submarginal cells.

In the others, the labium is nearly straight, or slightly folded beneath at the tip; the maxillæ more elbowed, and the cubital cells three in number, as in

Sphecodes, having the male antennæ nodose, and the middle labial lobe short;

Halictus, in which the females have a longitudinal slit at the apex of the abdomen; and

Nomia, Latr., in which the legs of the males are swollen or dilated.

The second section of the Melliferæ, that of the APIARIÆ, comprises those species which have the middle division of the lower lip at least as long as the mentum or tubular sheath, and like a filament.

The maxillæ and labium are greatly elongated, and form a kind of proboscis, elbowed and folded beneath, in inaction. The two basal joints of the labial palpi have often the form of a compressed scaly seta; the two others are very minute, and affixed obliquely near the end of the second.

The Apiariæ are either solitary or social in their habits.

The Solitary Bees have never more than the two ordinary kinds of individuals, males and females, each female providing alone for the support of her posterity. The hind feet of these females are furnished with neither pollen baskets, nor silken pollen brushes. They are provided on the outside with numerous close hairs.

A first division of Solitary Bees comprises those which have the second joint of the posterior tarsi inserted in the middle of the extremity of the preceding joint.

The *Andrenoides* approach the Andrenetæ in having the labial palpi composed of slender joints, placed end to end, and similar to the 6-jointed maxillary palpi; the females have no ventral brush, but their hind legs are provided with bundles of hairs, with which they collect pollen.

The three following have the mandibles of the females narrowed at the tip.

Systropha, Illig., has a tooth beneath the apex; three complete cubital cells, and the male antennæ curled.

Rophites, Spin., with similar mandibles, but having only two complete cubital cells, and the antennæ never curled.

Panurgus, with the mandibles not toothed; the wings with two complete cubital cells.

Xylocopa, Latr., or the Carpenter Bees, have the mandibles nearly spoon-shaped; the labrum is ciliated in front; the upper wings have three complete cubital cells, the first of which is cut in two by a transparent line. The male in many species differs greatly from the females, which resemble great Humble Bees; their wings are often violet, copper, or golden-coloured, and brilliant. Type, *Apis violacea*, Linn. [a continental species, the female of which forms long burrows in wood, palings, &c., in which it makes several cells, in each of which it deposits an egg and a supply of pollen paste. The species are numerous, and chiefly inhabitants of tropical climates.

The labial palpi of the other Apiariæ resemble scaly plates; the two basal joints very long; the maxillary palpi short, and often with fewer than six joints.

The *Dasygastræ* are remarkable for the under side of the abdomen of the females being furnished with a stiff, silky coat of hairs; the labrum is as long as broad, and square; the mandibles of the females strong, triangular, and toothed.

Ceratina, Latr., approaches Xylocopa, the only subgenus which has 6-jointed maxillary palpi, and three complete cubital cells. The abdomen is oval, and destitute of a ventral brush, as well as in *Stelis* and *Cœlioxys*, which nevertheless ought, from their general characters, to form part of this group.

All the other Dasygastræ have never more than four joints in the maxillary palpi, and two complete cubital cells.

Chelostoma, Latr., has the body long and subcylindric; the mandibles advanced, narrow, and curved; and the maxillary palpi 3-jointed.

Heriades, Spin., has the body also long and subcylindric, but the mandibles are triangular, and the maxillary palpi 2-jointed.

In the four following subgenera, the abdomen is shorter and subtriangular, or semi-oval. These are Mason Bees and Leaf-cutter Bees.

Megachile, Latr., has the maxillary palpi 2-jointed; the abdomen flat above, and capable of being elevated so as to be able to use their sting above their bodies. *M. muraria* [a continental species], with violet-coloured wings, makes its nests of fine earth, and fixes them against walls exposed to the sun, each nest containing from twelve to fifteen cells. Other species, named Leaf-cutter Bees, employ in the construction of their nests portions of leaves, perfectly oval or circular, which they cut out of leaves with their jaws with surprising dexterity; these they carry to their burrows made in the earth, or sometimes in walls, or the trunks of old trees, forming cells of them of the size of a thimble, and inclosing an egg in each cell, with a supply of pollen paste, the cover of one cell forming the bottom of the next above it, and so on until the burrow is filled. Of this number is *Apis centuncularis*, Linn., [a common British species].

Lithurgus, Latr., has 4-jointed maxillary palpi, and the abdomen depressed above. [Exotic species.]

Osmia, Panzer, has also 4-jointed maxillary palpi, but the abdomen is convex above. Some of the species of this genus, [which is numerous,] are Mason-bees, and others Leaf-cutters; amongst the latter is the Tapestry-bee of Réaumur, which uses portions of the wild scarlet poppy to form its nests. It belongs to Saint Fargeau's genus *Anthocopa*, differing from Osmia in having tridentate instead of bidentate mandibles. Some species make their nests in the galls of trees.

Anthidium, Fabr., has the abdomen convex, and the maxillary palpi only 1-jointed. The females strip off the cottony matter growing upon various wild plants, in order to form their nests therewith.

Stelis, Panz. (with the scutellum simple and the abdomen semicylindrical), and

Cœlioxys, Latr. (with two teeth or spines to the scutellum, and the abdomen triangular), differ from the preceding and agree with the following in wanting the ventral brush, which leads to the supposition that they are parasites.

Other Apiariæ, forming the subdivision *Cuculinæ*, are similar to the preceding in their posterior tarsi, and also in the labial palpi, which are like scaly setæ; but they are destitute in both sexes of a ventral pollen-brush, and have the labrum in the form of an elongated, truncated triangle, or short and nearly semicircular. The scutellum is emarginate, bidentate, or tubercular. They appear to deposit their eggs in the nests of other Bees, whence I have given them the name of Cuckoo-bees.

Some, nearly glabrous, have the paraglossæ much shorter than the labial palpi.

Ammobates, Latr. (with 6-jointed maxillary palpi), and

Phileremus, Latr. (with 2-jointed maxillary palpi), have the labrum elongate-triangular. In others it is short, semicircular, and semi-ovate.

Epeolus, Latr. (with three complete cubital cells, and 1-jointed maxillary palpi), and

Nomada, Fab., have three complete cubital cells; the last has 6-jointed maxillary palpi. [A very numerous genus, the species of which greatly resemble small Wasps.]

Pasites, Jur., has only two cubital cells and 4-jointed palpi.

Other Cuculinæ have the body hairy in spots, and the paraglossæ nearly equal the labial palpi in length.

Melecta, Jur., with 5- or 6-jointed maxillary palpi. [*M. punctata*, a common, handsome British Bee.]

Crocisa, Jur., with 3-jointed maxillary palpi, and the scutellum elongated and notched.

Oxæa, Klug, has the labrum oblong, and the maxillary palpi obsolete or only 1-jointed, and very minute.

The terminal subdivision of the Solitary Bees, named *Scopulipedes* from the thick coating of hairs of the hind legs, in which also the basal joint of the tarsi has its outer edge dilated, so that the following joint is inserted nearer to its inner angle. The under side of the abdomen is naked, or destitute of a pollen brush.

In some the maxillary palpi are composed of four or six joints, and in many of these the mandibles have only one tooth in the inside. They fly with great rapidity, and make a loud buzzing.

Eucera, Latr., comprising those species which have the two lateral divisions of the labium as long as the labial palpi, and the males have very long antennæ. *Apis longicornis*, Linn. [a common British species].

Macrocera, Spin., differs from Eucera, having only 5-jointed maxillary palpi, and only two cubital cells.

Melissodes, Latr., an American Eucera, with 4-jointed maxillary palpi, and three cubital cells.

The others of this subdivision have the paraglossæ much shorter than the labium, and always three cubital cells; and some have 6-jointed maxillary palpi.

Melitturga, Latr., (with the male antennæ clavate, and the palpi continuous).

Anthophora, Latr., (with the antennæ filiform, and the two terminal joints of the labial palpi minute and oblique). [*A. retusa*, a common British species, and] *A. parietina*, make their nests in walls, the latter forming a perpendicular curved tube at its orifice, composed of grains of earth, which it destroys when it has finished laying its eggs.

Saropoda, Latr., have only five joints in the maxillary palpi, and those of the labial palpi are continuous.

Ancyloscelis, Latr., has only 4-jointed maxillary palpi; the females have a strong toothed spine at the tip of the posterior tibiæ. Brazilian insects. My genus *Melitoma*, having been established upon females of this genus, must be suppressed. *Tetrapedia*, Klug, also enters into the preceding genus.

Centris, Fabr., differs from the preceding in having the mandibles generally with several teeth within, and the maxillary palpi, as in the preceding, have only four joints. American insects.

In the two following subgenera the maxillary palpi have only a single joint, which is obsolete in some species.

Epicharis, Klug, has the labial palpi continuous, and each of the second and third cubital cells receives a recurrent nerve.

Acanthopus, Klug, has the two terminal joints of the labial palpi forming a small oblique branch, and the third cubital cell receives two recurrent nervures.

The terminal Apiariæ are social in their habits, the societies consisting of males, females, and neuters, the feet of the last of which have the outer face of the tibiæ furnished with a smooth excavation, or pollen basket, in which they place the pollen mass, which they have collected with the silken coating of the inside of the basal joint of the hind tarsi. The maxillary palpi are very minute, and composed of a single joint. The antennæ are elbowed.

Some have the posterior tibiæ terminated by two spines.

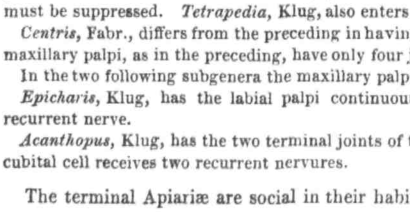

Fig. 122.—Humble Bee, with jaws of the male and female.

Euglossa, Latr., has the labrum square, and the proboscis as long as the body. Some of these have the body nearly glabrous, as *E. dentata*, *cordata*. The hind surface of the basal joint of the two posterior tarsi is nevertheless coated with a brush. Their habits are unknown. Others have the hind tibiæ convex: we also observe near the outer edge a narrow longitudinal impression. *Aglae*, St. Farg., seems established upon such individuals.

Bombus, has the labrum transverse, with the proboscis shorter than the body; the body is robust and very hairy; the hairs often arranged in coloured bands. The Humble Bee, *B. lapidarius*, so well known to children, is the type of this genus, the species of which live in underground

habitations in societies of fifty or sixty, but sometimes two or three hundred individuals: the society is, however, broken up at the approach of winter [like that of the Wasps]. The males are distinguished by their small size, the mandibles narrower, bidendate, and bearded, and the body often differently coloured. The females are the largest, and have the mandibles spoon-shaped, as they are also in the neuters, which are intermediate in size between the two others. Réaumur and Huber have observed two varieties amongst the neuters, differing in size from the ordinary ones: according to the latter author, several of the workers which are produced in the spring, couple in June with males which are produced from the common parent, and soon afterwards deposit eggs, which produce only males, which fecundate the females which only appear towards the end of the summer, and which are destined to become the foundresses of fresh colonies in the following year; all the rest perish. These females, which survive the winter, employ the first fine days in spring to commence their nest, which is formed in the earth, often at one or even two feet deep. One species, *B. lapidaria*, builds it on the surface of the ground, under stones. The cavities in which these nests are formed, are vaulted with earth and moss, which the Bees card with their hind legs. A layer of rough wax lines the interior of the nest. Sometimes an opening is merely made into the bottom of the nest, but sometimes it is one or two feet long, and lined with moss. A layer of leaves lines the floor of the nest, on which the female deposits masses of brown wax, their inner spaces being destined to inclose the eggs and larvæ. These larvæ there live in society until the period when they are ready to change to pupæ, when they separate, and each forms for itself a silken cocoon of an oval form, attached to each other vertically, the pupæ being always head downwards; hence they always make their escape out of the bottom of the cocoon on arriving at the imago state. Réaumur asserts that the larvæ feed upon the wax which forms their abode; but in the opinion of Huber, it simply protects them from the cold; the food of these larvæ consisting of a large supply of pollen paste moistened with honey, with which the pupæ provide them: there are, moreover, found in the nests two or three small cups of honey always open.

The larvæ appear four or five days after the eggs are deposited, and undergo their changes in the months of May and June. The workers remove the wax around the cocoon in order to facilitate the escape of the Bee. It has been supposed that these produced only neuters, but we have seen above that they also produce males. These workers assist the female in her works. The number of the cocoons, which serve for the abode of the larvæ and pupæ, increases, forming irregular layers of cells, one above another, on the sides of which the brown matter, which Reaumur names patée, is ordinarily found. The wax which these insects make, has, according to Huber, the same origin as that of the Domestic Bee, being only an elaborated kind of honey, which exudes from between the segments of the abdomen; several females live on good terms together in the same nest; the females are far less productive than the queen of the hive. [The species are very numerous. Types, *Apis muscorum*, Linn., the Moss-carder Humble Bee]; *Apis lapidaria* [the Lapidary Humble Bee, which builds amongst stones, but also uses moss]; and *A. terrestris*, [which builds in the ground without using moss. The females of some Humble Bees are destitute of apparatus for carrying pollen paste on the hind legs, and are consequently considered as parasites. They form the genus *Psithyrus*, St. Farg., changed by Newman to *Apathus*.]

The other Social Bees have no spurs at the extremity of the posterior tibiæ.

APIS, Linn.,—

The workers of which have the basal joint of the hind tarsi oblong, and furnished on the inside with transverse rows of short hairs.

Apis mellifica, Linn., or common Hive Bee, is much smaller and more oblong than the Humble Bee; the body

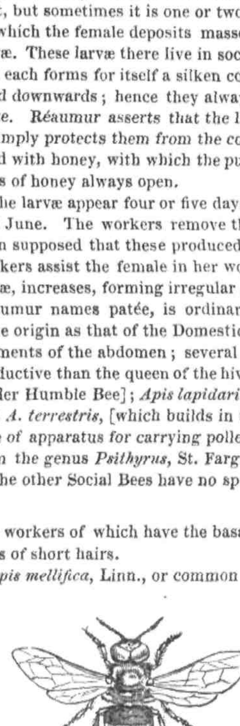

Fig. 123.—Drone Bee.

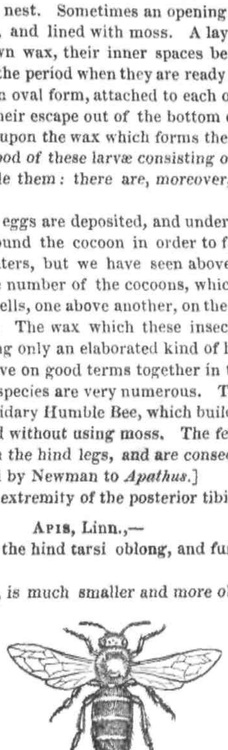

Fig. 124.—Queen Bee

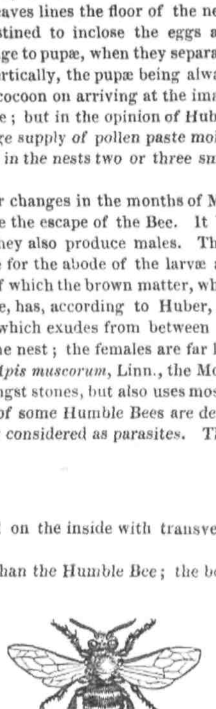

Fig. 125.—Neuter Bee.

is clothed with a plush in some parts, and its colours are but little varied; the Hive consists of neuters or Workers, of which the number is from 15,000 to 20,000, or even sometimes 30,000,—of about 600 or 800, or even sometimes more than 1000 males, and which are commonly called Drones, and generally of a single female, which the ancients called the King, and the moderns term the Queen. The workers, smaller than the other individuals, have 12-jointed antennæ and 6-jointed abdomen; the basal joint of the hind tarsi dilated into a pointed ear at the outer basal angle, and covered on the inside with a short, fine, close silken coating, and armed with a sting. The female exhibits the same characters, but the workers have the abdomen shorter, the mandibles spoon-shaped, without teeth; the outside of their hind tibiæ are also furnished with the pollen basket; the coating of the basal joint of the hind tarsi has seven or eight transverse striæ. The males and females are larger, with the mandibles notched beneath the tip, and pilose; the proboscis is shorter, especially in the males. These differ from the two other kinds in having 13-jointed antennæ; the head rounded; the eyes large, and united on the crown; the mandibles smaller and more hairy; the want of a sting; the four hind feet short.

The ventral segments of the workers, with the exception of the first and last, have within two pockets, where the wax is secreted and moulded into plates, which are discharged between the ventral segments. The wax, according

to the younger Huber, is but an elaboration of honey; and the pollen, mixed with a little of this substance, serves only for the food of these insects and their larvæ.

Huber distinguishes two kinds of Worker Bees: the first, which he calls Wax Workers, are charged with the gathering of food and other materials for the building, and in their employment; the others, or Nurse Bees, are smaller and weaker, formed for retreat, and employed solely in the nourishment of the young, and the interior economy of the hive.

We have seen that the workers resemble the females in various points: various curious experiments have proved that they are of the same sex, and that they may be transformed into Mother Bees, if, whilst larvæ, and during the three first days of their existence, they receive a peculiar nourishment, such as is alone given to the larvæ of the future queens; but they cannot in such cases acquire all the faculties of the latter, unless they are then placed in a large cell, similar to the royal cell of the queen larvæ. If, fed with this kind of food, their abode is not changed, they become capable of laying only male eggs, and differ from the true queens by their smaller size; the worker Bees are therefore nothing else than females, of which the ovaries, on account of the nature of the food with which they are fed whilst larvæ, remain undeveloped.

The matter of which the honey-comb is composed not being able to resist the inclemencies of the weather, and these insects not possessing the instinct to form a general envelope, they establish themselves in cavities where their labours find a natural defence. The workers, on whom alone the labours of the hive devolve, form with the wax honeycombs consisting of double layers of hexagonal cells, which latter are opposed to each other, base to base, the base of each cell being pyramidal, and consisting of three rhombs. The combs are always perpendicular, parallel, and fixed either by the upper part or side, and separated from each other by spaces which permit the passage of the Bees: hence the direction of the cells is always horizontal. Mathematicians have demonstrated that their form is at once the most economical in respect to the quantity of wax required, and the most advantageous in respect to the space occupied by the cells. The Bees, however, have the instinct to modify their form according to circumstances. If we except the cell fitted for the larva and pupa of the queen, these cells are nearly of equal size; some contain the young brood, and others the honey and pollen of flowers; amongst the honey-cells, some are open, others closed for reserve. The rpyal cells, of which the number varies from two to forty, are much larger, nearly cylindrical, rather thickened at the tip, with small cavities on their outer surface. They are generally suspended like stalactites upon the edges of the comb, so that the larva is always in a reversed position; some weigh as much as 150 ordinary cells. The males' cells are of an intermediate size between those of the queens and workers, and are placed irregularly here and there. The Bees always extend their comb from the top downwards. They stop up the small apertures of the habitation with a kind of mastic, which they collect from different trees, called propolis.

The coupling takes place at the beginning of summer, out of the hive, and it is supposed that a single fecundation suffices for all the eggs which the female deposits during the course of two years, and probably during all her life. The deposition of eggs takes place rapidly, and ceases only in autumn; Réaumur calculates that the female deposits 12,000 eggs in the course of twenty days in the spring. Guided by her instinct, she makes no mistakes in the choice of the cells which are proper for the different eggs; sometimes, however, when there are not sufficient cells, she places several eggs in one, which the neuters subsequently remove. Those which are deposited on the return of spring, are always the eggs of workers, which hatch at the end of four or five days. The Bees take care to give their larvæ the necessary paste proportioned to their age and sex; and seven days afterwards they are ready to become pupæ, when their cells are closed with a convex lid by the workers, whereupon the larvæ line the interior with a layer of silk, spin a cocoon, and become pupæ. In about twelve more days they become Bees, and disengage themselves from these cells. The workers then clean out the cells they have left in order to be ready to receive another egg. It is, however, otherwise with the royal cells, which are destroyed, and the Bees construct new ones if necessary. The eggs containing the males are deposited two months later, and those of the females soon after the latter.

This succession of generations forms so many particular societies, capable of forming fresh colonies, and which are known under the name of swarms; a hive sometimes produces three or four in the year, but the last are always weakest. Those which weigh from six to eight pounds are the best. When they become too numerous in the hive, these swarms quit their old abode. Various particular signs indicate to the cultivator the loss which he is about to sustain, and which he endeavours to prevent, or rather, to turn the emigration to his own advantage. Bees sometimes undertake violent combats amongst themselves: the males also, after they have impregnated the females, from June to August, are destroyed by the workers, which also kill the male larvæ and pupæ.

Bees have both internal and external enemies, and are subject to different diseases.

The Bee-keeper pays much attention to these insects, choosing the most approved hives, namely, such as are the least expensive in construction, the most favourable for the rearing of the Bees, and the best adapted for their preservation. He studies their habits, prevents the occurrence of accidents to which they are liable, and, in return, finds that he is well repaid for his trouble. The origin of bee-keeping is hidden in the darkness of antiquity, with the ancients they were the hieroglyphic symbol of royalty.

All the species of *Apis* proper are confined to the old world: those of the south and east of Europe, as well as of Egypt [and India], differ from our species, which has been transplanted to America and other colonized parts, where it has become acclimatised.

The terminal subgenus of Social Bees is

Melipona, Illig. (*Trigona*, Jur.), which differs from the preceding by having the basal joint of the hind tarsi o. the workers of a reversed triangular form, and without transverse striæ; the fore-wings have only two cubital

cells. The species inhabit South America; they build their nests on the summit of trees, or in their cavities. The honey of *M. Amalthea* is very agreeable, but very fluid, and soon becomes corrupt. It furnishes to the Indians a spirituous liquid, of which they are very fond. It appears that some species of Melipona have been found in the island of Sumatra. M. Cordier possesses a piece of amber, inclosing a specimen of *M. Amalthea*. [I question whether this insect was not inclosed in gum copal, or anime, and not in amber. I have seen many Meliponæ inclosed in the gum anime.]

The species without teeth in the mandibles are *Melipona* proper; those with teeth form the genus *Trigona*.

[The recent work of the Comte de Saint Fargeau, forming part of the *Suites de Buffon*, must be consulted, as well as the tenth volume of the *Encyclopédie Méthodique*, for many additional facts and genera established relative to the family of the Bees. Also the work of Dr. Bevan on the Honey Bee, and the volume on Bees in the *Naturalist's Library*; whilst the *Monographia Apum Angliæ* of Mr. Kirby may be mentioned as one of the most perfect examples of an entomological monograph which has ever been published.]

THE TENTH ORDER OF INSECTS,—

LEPIDOPTERA, Linn. (GLOSSATA, Fabr.),—

Terminates the series of those which have four wings, and presents to us two characters which are especially peculiar to it.

The wings are covered on both surfaces with small coloured scales, similar to a farinose powder, which comes off on being touched. A proboscis, or tongue, rolled up in a spiral direction between two palpi, clothed with scales or hairs, forms the most important part of the mouth, and with which these insects draw up the nectar of flowers, which is their only nourishment. We have seen, in the remarks on insects in general, that this proboscis is composed of two tubular filaments, representing the maxillæ, each bearing at its base externally a very small palpus, like a tubercle. The visible palpi, or those which form a kind of sheath to the tongue, replace the labial palpi of masticatory insects, being cylindrical, or conical, generally turned upwards, 3-jointed, and inserted upon a fixed labium, which forms the portion of the lower part of the oral cavity below the proboscis. Two minute pieces, situated one on each side, at the anterior and superior edge of the front of the head, near the eyes, seem to be the vestiges of mandibles; and we also discover, in an equally rudimental form, the labrum.

The antennæ are variable, and always composed of a great number of joints. In many two ocelli are visible, but hidden beneath the scales of the head. The three segments of which the thorax of hexapod insects is composed, are united into a single body, the first being very short, and the two others confounded together. The scutellum is triangular, but pointed towards the head; *the wings are simply veined, and variable in figure, size, and position.* In many the hind pair have several longitudinal folds towards the inner edge; at the base of each of the upper wings is a piece like an epaulette, prolonged behind, which corresponds with the tegula of the Hymenoptera; but, in its more developed state in this order, I call it the *pterygoda*. The abdomen, composed of six or seven joints, is attached to the thorax by a very small portion of its diameter, and is furnished with neither sting nor ovipositor analogous to that of the Hymenoptera. In many females, however, as in Cossus, the terminal segments are elongated and narrowed, so as to form an oviduct, like a pointed and retractile tail. The tarsi have constantly five joints. The species always consist only of males and females; the latter ordinarily deposit their eggs, which are very numerous, upon vegetable substances, upon which the larvæ feed, and after which the females soon die.

The larvæ of Lepidopterous insects are known under the name of Caterpillars. They have six scaly feet, corresponding with those of the perfect insect, besides from four to ten membranous feet, of which the two last are situated at the posterior extremity of the body, near the anus: those with only ten or twelve feet are called Geometers, or Loopers, from

their peculiar mode of walking. Seizing fast hold of the objects on which they are stationed with these six fore-legs, they elevate the intermediate segments of the body into an arch, until they bring the hind-feet close to the others; these they disengage, and, retaining hold with the hind feet, thrust forward the body to its full length, and then recommence the same manœuvre. Many of these Looper-caterpillars resemble, in their mode of standing, fixed for a great length of time only by their hind legs to twigs, as well as in their form and colours, small pieces of stick. Such an attitude necessarily requires a prodigious muscular force, and Lyonnet has, in effect, discovered that the caterpillar of the Goat Moth possesses 4041 muscles. Some Caterpillars with fourteen or sixteen feet, (some of the intermediate membranous legs being, however, smaller than the others,) have been named Semi-geometers. The membranous feet are mostly terminated by a more or less perfect coronet of little hooks.

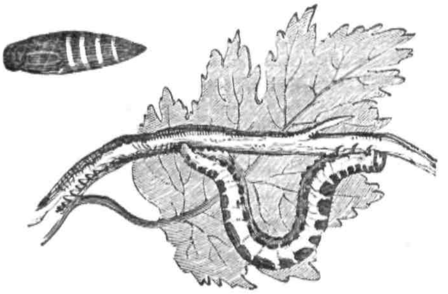

Fig. 126.—Caterpillar and Chrysalis of the Magpie Moth.

The body of these larvæ is generally long, subcylindric, soft, variously coloured, sometimes naked, and sometimes hairy, tubercled, or spined, and consists of twelve segments, exclusive of the head, with nine spiracles on each side ; the skull is horny or scaly, with six small granular shining points, which seem to be ocelli, on each side : it has moreover two very short conical antennæ, a mouth composed of a pair of strong mandibles, two maxillæ, a labium, and four small palpi; the silky material which it uses is elaborated in two long, tortuous, internal vessels ; a tubular and conical point, situate at the tip of the labium, is the spinneret, whence the silk is discharged. The majority of Caterpillars feed upon the leaves of vegetables; others devour flowers, roots, buds, seeds ; others eat the hard and solid parts of the wood; this they soften with a secretion which they discharge from the mouth : certain species destroy our woollen cloths, stuffs, furs, &c., and are the most obnoxious of our domestic insects ; others feed on grease, fat, bacon, wax, &c.; many feed upon a single material, but others, less delicate, attack different kinds of plants. One of the most striking instances of providence is the perfect coincidence between the appearance of the Caterpillar and the vegetable upon which it is destined to feed. Some kinds of Caterpillars are social, and often live together under a kind of tent of silk, which they spin in common, and which serves them as a defence against bad weather; many fabricate cases, either fixed or portable ; some are lodged in the parenchyme of leaves, where they make galleries; the greater number however delight in daylight; others, on the other hand, only come forth at night. Winter, notwithstanding its rigours, so uncongenial to nearly all insects, is the period when some moths make their appearance. Caterpillars generally moult four times before passing to the chrysalis state. The majority then spin a cocoon in which they are inclosed ; a kind of meconium or red liquid, which these insects discharge at the moment of their final transformation, softens one end of the cocoon, and allows the escape of the moth. Generally one end of the cocoon is weaker, or even fitted by the arrangement of the threads for the escape of the insect. Other Caterpillars merely content themselves with attaching together leaves, or particles of earth, &c., with silken thread, thus forming a rough kind of cocoon. The Chrysalides of diurnal Butterflies are ornamented with golden spots [whence their name of Aureliæ or Chrysalides], and are naked, and fixed by the posterior extremity of the body; these Chrysalides are of the peculiar kind which Linnæus termed *Pupa obtecta*, and which are mummy-shaped; the sheaths of the feet and antennæ being fixed. Those of many species, especially of Butterflies, are hatched in a few days ; and thus there are two broods of these in a year. But in respect to others, these Cater-

pillars or Chrysalides pass the winter, and the insect only undergoes its change in the spring or summer of the following year. In general the eggs deposited in the autumn are not hatched till the next spring. They escape from the chrysalis in the ordinary manner, or by a slit down the back of the thorax.

The larvæ of Ichneumonidæ and Chalcididæ rid us of a great number of these destructive insects.

[The arrangement of this order cannot be considered as arrived at an equal degree of perfection with that of the Coleoptera, or some other orders. Dr. Horsfield, in his *Lepidoptera Javanica,* has attempted a more natural classification, founded especially upon the transformations of these insects, but his work is incomplete ; as is also the case with Boisduval's *Histoire naturelle des Insectes Lepidoptères.* The British species have been described in detail by Mr. Stephens, in whose work, as well as in that of Curtis, great numbers of new genera are introduced ; there still, however, requires a more minute investigation of the generic characters of these insects, and especially of the exotic species, than has yet been given to them ; authors having generally contented themselves with describing or figuring the beautiful marking of the wings, without attending to the real generic or structural peculiarities.]

We divide this order into three families, which correspond with the three genera of which the order is composed in the Linnæan system.

THE FIRST FAMILY OF THE LEPIDOPTERA,—

THE DIURNA [or Butterflies],—

Is the only one in which the outer edge of the hind-wings is not furnished with a scaly and stiff bristle like a bridle, to retain the two fore-wings, which, as well as the others, generally, are elevated perpendicularly in repose ; the antennæ are terminated either by a knob, or are nearly of the same thickness, or even more slender, and terminated in a bent hook at the tip. This family corresponds with the genus

PAPILIO, Linnæus.

The caterpillars have always sixteen feet. The chrysalides are nearly always naked, attached by the tail, and mostly angular. The perfect insect, always furnished with a proboscis, only flies by day, and the colours of the under side of the wings are equal in beauty to those of the upper.

We divide them into two sections.

The first have only a single pair of spurs to the tibiæ, placed at the tips ; the fore-wings are elevated perpendicularly in repose ; the antennæ are mostly clubbed at the tip, which is truncated, or rounded, or are sometimes nearly filiform. This very numerous section may be further divided as follows.

1. Those with the third joint of the palpi either obsolete, or if present, clothed with scales as thickly as the preceding joint, and the tarsal claws very distinct. Their caterpillars are elongate, subcylindric ; the chrysalides are almost always regular, sometimes smooth, but inclosed in a rough cocoon ; some of these (Hexapoda) have all the legs fit for walking, and nearly alike in both sexes : the pupa is not only attached by the tail, but by a thread round the middle of the body ; the central cell of the hind wings is closed externally.

The four following genera have the inner edge of the hind wings concave or folded.

Papilio proper, or the *Equites* of Linnæus, have the lower palpi very short, scarcely reaching the clypeus, with the third joint scarcely distinct. Their caterpillars, when alarmed, throw out a forked horn from the neck, which emits a disagreeable scent.

These Butterflies are remarkable for their size and the variety of their colours. They are generally found in the equatorial regions of both worlds ; many have the hind wings prolonged into a tail, as in our *Papilio Machaon*, or the Swallow-tail Butterfly.

Zelima, Fabr., differs from Papilio only in having the club of the antennæ shorter and rounder. [Two exotic species.]

Parnassius, Latr. (*Doritis*, Fabr.), have the palpi elevated above the clypeus, and pointed, with three distinct joints; the caterpillars have a retractile tentacle in the neck, but they form a kind of cocoon with leaves. *P. Apollo*, [a reputed British species], which, with the others, is only found in mountainous districts.

Thais, Fab., has palpi like Parnassius, but the club of the antennæ is elongated and curved ; the caterpillars are apparently destitute of the retractile tubercle in the neck. The species are found in the South of Europe.

In the following the lower wings extend beneath the abdomen, and form a kind of gutter for it; their larvæ are destitute of a tentacle in the neck; and many of them subsist on cruciferous plants. These Lepidoptera (*Papilio Danai candidi*, Linn.), form two subgenera.

Pieris, Schrank. (*Pontia*, Fab.), has the palpi subcylindric, slightly compressed, with the last joint nearly as long as the preceding, and the club of the antennæ ovoid. *P. brassicæ*, Linn., the Great Garden white Butterfly, &c.

Colias, Fab., having the antennal club elongate, obconic, and the palpi very compressed; with the last joint much shorter than the preceding. *C. edusa*, and *Hyale*, Linn., the Clouded yellow Butterflies, &c.

The other Butterflies of the same division are named *Tetrapods*, from having the two fore-legs very small, and folded up, and not fitted for walking, either in both sexes, or only in the males; the chrysalis is suspended only by the tail, and hangs with the head downwards. In some of these, the fore-legs, although small, scarcely differ in form from the hind ones; the hind wings have the central cell always posteriorly closed; the palpi are wide apart, slender and cylindric, and short. All these subgenera are exotic.

Danais (*Euplœa*, Fab.), has the wings triangular, and the antennæ terminated by a long and curved knob.

Idea, Fab., has the wings nearly oval, elongated, with the antennæ nearly filiform.

The two following subgenera differ in having the wings more elongate and narrow, and the abdomen is very long.

Heliconia, Latr. (*Mechanitis*, Fab., *P. Heliconii*, Linn.), has the antennæ long and gradually thickened.

Acræa, Fab., has them shorter, and suddenly clubbed.

In the others (*P. nymphalis*, Linn.), the two fore-legs are more strongly bent, and either visible and very hairy, or concealed and minute. The hind wing has the central cell open in many, the palpi are longer, and often thicker and close together.

Those with the palpi rather compressed, apart in their whole length, and terminated by a slender joint, [are known under the name of Fritillary Butterflies,] having the under-side of the wings ornamented with silver, or yellow spots on a buff ground. The caterpillars are very spinose.

Cethosia, Fab., has the tarsal ungues simple, and the club of the antennæ oblong.

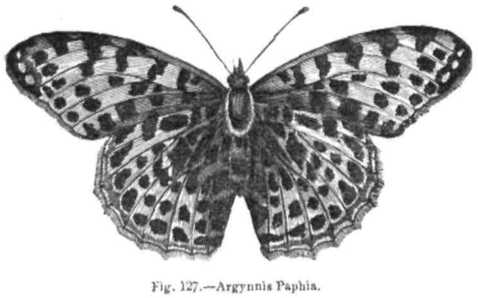

Fig. 127.—Argynnis Paphia.

Argynnis, Fab., has pearly spots on the under-side of the wings; the caterpillars are very spinose, with two longer spines on the neck, and the tarsal claws are unidentate.

Melitæa, Fab., has the caterpillars furnished with small villose tubercles; the wings are spotted, the pearl being replaced by yellow.

Those with the palpi contiguous throughout their whole length, and gradually pointed to the tip, and very compressed, compose five other subgenera.

Vanessa, Fab., are separated from the following by the antennæ suddenly terminated by a short knob. The caterpillars are very spinose. [This subgenus comprises some of the most beautiful of our British Butterflies, such as *Papilio Antiopa*, Linn., or the Camberwell Beauty; *Pap. Io*, Linn., the Peacock; *Pap. Cardui*, Linn., the Painted Lady; *Pap. Atalanta*, Linn., the Red Admiral; *P. Polychloros*, Linn., the Large Tortoise-shell; *Pap. Urticæ*, Linn., the Small Tortoise-shell; *Pap. C. album*, the Comma Butterfly], the chrysalis of which last rudely represents a human face, or the mask of a satyr.

In the four following subgenera the antennæ are terminated by an elongate mass, or are nearly filiform. The caterpillars are either naked, or armed with but few spines.

Libythea, Fab., in which the males alone have the fore-legs minute, and the palpi very advanced like a beak.

Biblis, Fab. (*Melanitis*, Fab.), have the palpi also longer than the head, but obtuse at the apex; the fore-legs short, and folded up in both sexes; the wings broader and simply toothed; the nerves of the fore-wings dilated at the base.

Nymphalis, Latr., is similar to Biblis in the feet, but with the palpi shorter, and differing from Vanessa only in the longer club of the antennæ; but the caterpillars have fewer spines, or merely fleshy prominences; they are narrowed to the extremity of the body, which is rather forked. These Butterflies are generally beautifully ornamented, and have a rapid and high flight. The males of some have changeable reflexions in their hues, [as in the Purple Emperor, *Papilio Iris*, Linn.]. The form and size of the club of the antennæ vary a little, as well as the relative proportions of the wings, which have given rise to the establishment of several other subgenera: but their characters are very equivocal. The species which approach nearest to Biblis form the genus *Neptis*, Fab., whilst the furthest removed are *P. Jasius*, and the allied species, [forming the genus *Charaxes*, Bdv.]

Morpho, Fab., has nearly filiform antennæ, being but slightly thickened at the tips. All the species are South American, and of great size, with eye-like spots on the wings.

Pavonia, God., has the central cell of the hind wings closed, and the innermost nerve of the fore wings curved like an S. One of the species, *P. Phidippus*, from the East Indies, with the hind wings tailed, is the type of the genus *Amathusia*, Fabr.

The following have the discoidal cell of the hind wings closed behind.

Brassolis, Fab., has the antennæ suddenly clubbed, and the palpi short; the males have a longitudinal slit at the inner edge of the hind wings, covered with hair.

Eumenia, God., with the palpi longer, and the antennæ at a short distance from the base, gradually thickening, and forming an elongated mass.

Eurybia, Illig., has short palpi, but they are thicker, and the club of the antennæ is fusiform and bent.

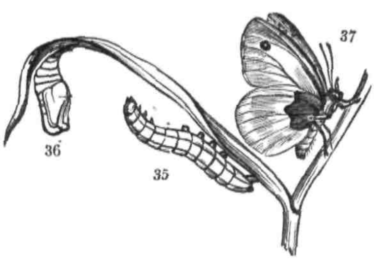

Fig. 128.—Satyrus (Hipparchia) pamphilus.

Satyrus, Latr. [*Hipparchia*, Fabr., and of English authors], has the palpi extending beyond the clypeus, very compressed, the antennæ terminated by a small club, or by a slender elongated mass; the two or three basal nerves of the fore-wings are swollen. The caterpillars are naked, or nearly smooth, with the extremity of the body forked. The chrysalides are bifid in front, and the back is tubercled. [This is a very numerous British genus, the majority of which are ornamented with eye-like spots. Such are *Pap. Galathea, Janira, Ægeria*, &c.]

We terminate this first section of the diurnal Lepidoptera by those which have the palpi 3-jointed, but the third joint is nearly naked, and much less clothed with scales than the preceding; the tarsal claws are very minute. The caterpillars are oval, or like Wood-lice. The chrysalides are short, entire, and always attached by a thread round the middle of the body, like those of *Papilio* or *Pieris*. Linnæus united them in his *Papiliones plebeii*, and division *Rurales*. They are the *G. Argus* of Lamarck, and Fabricius has divided them into many genera, which have need of revision.

Some of these have the antennæ terminated by a knob.

Erycina, Latr., has the fore feet, at least in the males, much shorter than the others. [These are almost exclusively South American Butterflies.]

In the others the fore-legs are like the others in both sexes.

Myrina, Fab., is distinguished by the great length of the palpi. [Exotic species.]

Polyommatus, Latr., thus named from the numerous eye-like spots on the wings, has the palpi not much extending beyond the clypeus. [The species are numerous, of small size, and are known under the names of Blues or Coppers.] The most abundant species of the former is *Pol. Alexis*, the Common Blue.

Other Lepidoptera of this division are furnished with antennæ of a completely isolated form.

Barbicornis, God., has the antennæ in both sexes setaceous and plumose. [Established upon a Brazilian species, which Latreille considered fictitious, but which is now well known to be real. Latreille here added the genus *Zephyrius*, Dalman, which he described as having the antennæ terminated by ten or twelve globular joints; the genus is, however, identical with Polyommatus. See Boisduval, *Hist. Nat. Lep.* i. p. 114.]

The second section of the Diurnal Lepidoptera is composed of species in which the posterior tibiæ have two pairs of spurs, one pair at the tip and another above, as in the two following families: the lower wings are generally placed horizontally in repose, and the extremity of the antennæ is often suddenly bent and pointed. Their caterpillars, of which, however, but a few are known, roll up leaves, in which they spin a thin web of silk, within which they are transformed to chrysalides, which have smooth bodies, and are without angular eminences. They form the division of the *Plebeii urbicolæ* of Linnæus, and were united with the Polyommati under the name of *Hesperia*, by Fabricius. But we must further add some exotic Lepidoptera, whose natural station has not yet been discovered. These different Lepidoptera conduct us very well to the second family. They compose two subgenera.

HESPERIA, Fab.,—

Which have the antennæ distinctly terminated by a club, and the palpi short, broad, and very squamose in front. [The species are very numerous, of small size, and are known to collectors under the name of Skipper Butterflies, from their peculiar flight.] *H. Malvæ*, Fab., is a common species. Its caterpillar is elongated, with the first segment behind the head narrowed, a character familiar to this group.

URANIA, Fab.,—

Has the antennæ filiform at the base, and gradually slender and setaceous at the tips, and the palpi long, slender, with the second joint very compressed, and the last long, slender, and naked. *Pap. Rhipheus, Leilus, Lavinia, Orontes*, &c. They form Dalman's genera *Cydimon, Nyctalemon*, and *Sematura*. [See the memoir of Mac Leay on the transformations of a species which inhabits Cuba, in the *Trans. Zool. Soc.*, and my observations on the affinities of these interesting insects, in the new edition of Drury's *Exotic Entomology*.]

THE SECOND FAMILY OF THE LEPIDOPTERA,—

THE CREPUSCULARIA,—

Has, near the origin of the external edge of the hind wings, a stiff bristle, which passes through a hook on the under side of the fore-wings, maintaining them whilst in repose in a horizontal or inclined position; according to Godart, however, some of the Smerinthi are nevertheless destitute of this instrument, which is also found in the following family, but the Crepusculariæ are distinguished by their antennæ forming an elongated mass, either prismatic or fusiform. Their caterpillars have always sixteen feet; their chrysalides are not angulated like those of the Diurnal Lepidoptera, and are mostly inclosed in a cocoon, or are concealed either in the earth or beneath some substance. They mostly fly either in the morning or evening [twilight]. This family composes the genus

SPHINX, Linn.,—

Which has derived its name from the peculiar attitudes of the larvæ, which resemble the fabled Sphinx. They make a humming noise during flight. I divide this genus into four sections, corresponding to the Fabrician genera *Castnia*, *Sphinx*, *Sesia*, and *Zygæna*.

The first, HESPERI-SPHINGES, is composed of Lepidoptera which evidently seem to connect the Hesperiæ and true Sphinges. The antennæ are always simple, thickened in the middle, or towards the tip, which forms a pointed hook without a bundle of hairs at the end. All have a very distinct proboscis, and the palpi are composed of three distinct joints. In some, the terminal joint is long, slender, and nearly naked, as in Urania; in others they are shorter and broader.

Agarista, Leach, has the palpi long, with the terminal joint nearly naked; the antennæ gradually thickened in the middle, and terminated by a long hook. [New Holland insects.]

Cocytia, Boisduval, has glass-like wings; the palpi are as in Urania, and the antennæ as in Agarista.

Coronis, Latr., has the palpi similar, suddenly terminated in a club, with a hook at the tip. [A Brazilian species.]

Castnia, Fabr., has the antennæ like those of Agarista, but the palpi are shorter, broader, and cylindric. [See the monographs of Dalman, Gray, and the *Encyclopédie Méthodique*.]

The second section, SPHINGIDES, has the antennæ always terminated by a small brush of scales; the palpi are broad or transversely compressed, very squamose, with the third joint mostly indistinct. The majority of the caterpillars have the body smooth, elongated, with a horn on the back, near the extremity of the body; and the sides oblique or longitudinally striped. They feed on leaves, and undergo their changes in the earth without weaving a web. Such are the species of

SPHINX, Linn. [or the Hawk Moths],—

Properly so called, which have the antennæ prismatic, simply ciliated, or striated on one side, and which have a distinct proboscis. They fly with great swiftness, hovering over flowers, and making a humming sound; the chrysalides of some species have the tongue-case exserted like a nose, as in *Sphinx Convolvuli*, the Unicorn Hawk Moth.

Fig. 129.—Acherontia atropos; reduced.

The species are numerous, and of very large size. One of the largest, is the Death's Head Moth, *Sphinx Atropos*, Linn. [belonging to the subgenus *Acherontia*, Och.], remarkable for the skull-like patch on the back of the thorax, and for the squeaking kind of noise it emits, which has been supposed by Réaumur to be caused by rubbing the palpi against each other, and by Lorey to be owing to the rapid escape of the air from two ventral cavities; the caterpillar is of a very large size, and feeds on potatoes, jasmine, &c.

The larvæ of other species [forming the subgenus *Eumorpha*, Hb., or *Metopsilus*, Duncan], have the power of thrusting out the front of the body to a great length, [whence they have obtained the name of Elephant Hawk Moths,] such as *Sph. Elpenor*, *Porcellus*, &c.

Other Sphingides have the body terminated by a tassel of scales. Scopoli formed them into a distinct genus, *Macroglossum*. Such are the Humming-Bird Hawk-Moth (*Sph. stellatarum*), and the Broad and Narrow-bordered Bee-Moths (*Sph. fuciformis*, *Bombyliformis*, &c.), the two last of which have the wings glassy. [This group of Hawk Moths is remarkable for flying in the hottest sunshine.]

Smerinthus, Latr., has the antennæ serrated, and the tongue wanting. The species are sluggish in their flight, and the hind wings extend beyond the fore ones in repose, as in many moths. *Sph. Tiliæ*, *Populi*, and *ocellata*.

The third division of Sphinx, SESIADES, comprises those with the antennæ always simple, elongate-fusiform, and often terminated by a small bundle of scales; the palpi are slender, and distinctly 3-jointed; the abdomen is generally terminated by a tassel. The caterpillars devour the interior of twigs, or the roots of vegetables, like those of Zeuzera or Cossus; they are naked, without any posterior horn, and construct a cocoon with the particles of the materials on which they have fed.

SESIA, Latr.,—

Has the antennæ terminated by a small brush of scales; the wings are horizontal, and have glassy spaces; the tail is tasselled. Many of the species resemble Wasps and other hymenopterous and dipterous insects. [Numerous small British species, which fly about in the hottest sunshine.]

Thyris, Hoff., differs in the antennæ being nearly setaceous, and the abdomen pointed.

Ægocera, Latr., has the antennæ without a bundle of scales at the tip, but thickest in the middle; the abdomen also pointed at the tip. The wings are entirely clothed with scales.

The fourth and last division of Sphinxes, ZYGÆNIDES, has the antennæ always terminated in a point without a brush, and either simple in both sexes and fusiform, or thickest in the middle; setaceous and pectinated, at least in the males; the palpi of moderate size, or small, subcylindric, 3-jointed; the wings are deflexed, and have, in many, vitreous spots; the abdomen is not tasselled; the spurs of the hind-tibiæ are small; the larvæ are exposed, and feed on various leguminosæ. They are cylindric, without a posterior horn, pilose, like those of many Bombyces, and form a silken cocoon, which they attach to stems of grass, &c. Their habits are well described by Boisduval, in a monograph on this tribe.

ZYGÆNA,—

The typical genus, is not found in the New World; the antennæ are simple in both sexes; suddenly terminated by a fusiform mass, and the palpi reach beyond the clypeus, and are attenuated at the tip. [The species are numerous.

Sphinx filipendulæ, [the Hornet Moth, a very common and handsome species, is the type].

Syntomis, Illig., differs in having the antennæ slender and gradually dilated; the palpi are shorter. [Exotic species.]

Atychia, Hoff., has simple antennæ in the females, or bipectinated in the males; the palpi very pilose, and extending considerably beyond the clypeus; the spurs large.

Procris, Fab. (*Ino*, Leach), approaches Atychia in the antennæ, but the palpi are shorter, the wings longer, and the spurs small. *S. statices*, Linn., [the Forester Sphinx, a very common small species, of a shining green colour].

The other Lepidoptera of this division have the antennæ in both sexes bipectinated.

Glaucopis, Fab., has a distinct proboscis.

Aglaope, Fabr., has not a proboscis. Many species of these two subgenera occur in tropical climates; they seem to connect the Crepusculariæ with Callimorpha.

THE THIRD [AND LAST] FAMILY OF THE LEPIDOPTERA,—

THE NOCTURNA,—

Presents to us ordinarily the wings bridled in repose by a bristle or bunch of hairs arising at the base of the outer edge of the lower pair, and passing through a ring on the under side of the upper. The wings are horizontal or deflexed, and sometimes rolled round the body. The antennæ gradually diminish to the tips, or are setaceous. This family is composed in the Linnæan system of the single genus

PHALÆNA [or Moths].

These insects in general fly only during the night, or after sunset; many are destitute of a proboscis; some females are destitute of wings, or have only very small ones. The caterpillars generally spin a cocoon; the number of their feet varies from ten to sixteen; the chrysalides are always rounded, and not angulated nor pointed.

The classification of this family is exceedingly embarrassing, and our systems are yet but imperfect sketches. We divide it into ten sections.

The first section, HEPIALITES, has for its types the genera *Hepialus* and *Cossus* of Fabricius. The caterpillars are naked and fleshy, and reside in the interior of vegetables, upon which they feed; their cocoons are for the most part formed of the particles of these vegetables. The segments of the abdomen of the pupæ are denticulated; the antennæ are always short, with only a single sort of small short teeth. In others they are terminated by a single filament, but furnished at the base in the males with a double

row of pectinations; the proboscis is always very short and indistinct; the wings are roof-like and elongated; the females have the ovipositor long; their caterpillars commit much havoc in different trees, &c.

In some, the antennæ are nearly alike in both sexes, with only very short teeth.

HEPIALUS, Fabr.,—

Which has these organs nearly moniliform, and much shorter than the thorax; the hind wings are generally destitute of a bridle. The caterpillars live in the earth, and eat the roots of plants. The Great Swift or Ghost Moth (*Hepialus Humuli*), is a very common insect; the male with silvery white wings, and the female buff, with reddish marks.

Cossus, Fab., has the antennæ longer, with a row of short denticulations; the caterpillars live in the interior of trees, forming their cocoons of the sawdust they make. The chrysalis, immediately before undergoing its final change, works itself to the outer opening of its cell, in order to make its escape. The Goat Moth, *Cossus ligniperda*, is the type of the genus. Its larva is like a thick, short, red worm; it lives in the interior of various trees, and discharges a fetid liquor when alarmed, and which serves to soften the wood.

Stygia, Drap., has a double row of teeth in the antennæ. [Exotic species.]

Zeuzera, Latr., differs from the preceding in having the male antennæ furnished at the base with a double row of long pectinations, and subsequently terminated by a thread; those of the females are simple, but cottony at the base. *Z. Æsculi*, the Wood Leopard, a handsome rare species, of a white colour, with numerous steel-blue spots. The larva lives in the interior of various trees.

Our second division, BOMBYCITES, differs from the first and third, by having the proboscis always very short and rudimental; the wings are extended and horizontal, or roof-like, the lower ones extending beyond the upper ones at the sides; and the male antennæ entirely pectinated. The larvæ are exposed, and feed upon the tender parts of vegetables; they mostly make a cocoon of pure silk; the chrysalides have no rows of teeth on the margins of the abdominal segments.

We form with the species which have the wings expanded and horizontal, a first subgenus, or the *Phalæna Attacus* of Linnæus, to which we restrict the name of

Saturnia, Schrank., including that of *Aglaia*. It comprises the largest species, which have the wings mostly ornamented with glass-like spots. Such are the Great Atlas Moth of China, *B. Cecropia*, *Luna*, &c. The silk of which the cocoons of two of the species are formed, has been employed from time immemorial at Bengal. I am assured by M. Huzard, that in a Chinese manuscript these caterpillars have been termed the wild Silk-worms of China, and I conjecture that the silken materials, obtained by the ancients in commerce, were produced from these caterpillars. Europe furnishes five species of this subgenus, the largest of which is the Great Peacock, *D. pavonia major*: the only British species is the Emperor Moth, [*B. pavonia minor*]; the cocoon of this species is curious, being formed internally with stiff, convergent, elastic threads, which facilitate the escape of the inclosed insect, but prevent the entrance of others.

The other Bombycites have the upper wings inclining at the side, or roof-like, the outer edge of the lower extending beyond that of the upper wings.

Lasiocampa, has the palpi porrected like a beak, and the hind-wings often notched. The perfect insect often resembles a packet of dead leaves. *B. quercifolia*, *potatoria*, &c. [divided by the German and English entomologists into numerous subgenera].

Bombyx proper, has the palpi not remarkably prominent.

B. Mori, Linn., the Silk-worm Moth. This well-known insect is a native of the northern provinces of China. It was imported by the Greek missionaries, in the time of Justinian, to Constantinople; whence, at the time of the crusades, it passed from Morea into Sicily and the kingdom of Naples, and subsequently, especially under Sully, into France. But the ancients also obtained their silks, both by sea and land, from Pegu and Ava, or the ancient Seres, which are the more generally alluded to in the writings of the earlier geographers. It is known that silk was anciently sold at its weight in gold, and that it has become an important source of national riches.

B. neustria, the Lackey Moth, the larva of which lives in society, under webs of large size, upon our fruit-trees; and *B. processionea*, the Processionary Moth, the caterpillars of which are also social, and which often change their abode, marching in procession, one being in front serving as a guide, followed by two, and then three, four, five, and so on.

The third section of the Nocturnal Lepidoptera, that of the PSEUDO-BOMBYCES, is composed of species in which the hind wings, like those of all the following, are furnished with a bridle, which fixes them to the anterior in repose, by which they are also then covered. The proboscis in the terminal species is elongated, differing only from the following tribes by being rather shorter. The antennæ are entirely pectinated, or serrated, in the males. The larvæ of all feed on the exterior parts of vegetables.

The first of these have the proboscis short, and unfitted for suction. In some of these the caterpillars do not form portable cases, and are long, and furnished with ambulatory feet.

Sericaria, Latr., has both sexes winged, and the upper wings are not denticulated on the inner margin. *B. dispar*, Fab. [the Gipsy Moth]. *B. versicolor*, *Bucephala*, *Coryli*, *pudibunda*, &c., forming the genera *Endromis*, *Pygæra*, *Liparis*, &c.

Notodonta, Ochs., has the inner margin of the wing denticulated, [whence these insects are called Prominent Moths].

Orgyia, Ochs., differs from the preceding by having the females almost wingless. *B. antiqua*, Fab. [the Vapourer Moth].

Limacodes, Latr., differs from all in having the caterpillars like Wood-lice, and which seem also to represent the Polyommati amongst the diurnal species. *H. Testudo* and *Asellus*, Fab.

Psyche, Schrank., the caterpillars of which form portable cases of silk, to which they affix bits of stick, thus resembling the nests of the Caddice-flies. Some of the species, from the East Indies and Senegal, are very remarkable in their forms.

The terminal Pseudo-Bombyces have the proboscis very distinct and elongated.

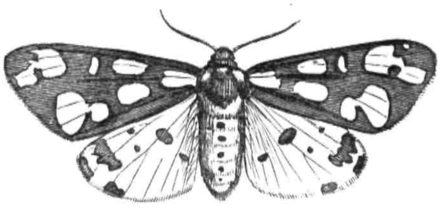

Fig 130.—Chelonia villica.

Chelonia, God. (*Arctia*, Schr., *Eyprepia*, Ochs.), has the wings roof-like; the antennæ pectinated in the males; the palpi very hirsute, and the proboscis short.

B. caja, the Great Garden Tiger Moth, having brown upper-wings marked with white, and red under-wings spotted with blue black. The larvæ are very common, and are termed Woolly Bears.

Callimorpha, Latr. (*Eyprepia*, Ochs.), has the wings roof-like, but the antennæ are only serrated in the males; the palpi only slightly squamose, and the proboscis long. *B. Jacobææ*, a very common species, black, the upper wings having a line and two carmine red spots; the under wings of the latter colour, bordered with black.

Lithosia, Fab., has the wings horizontal in repose.

The fourth section of the Nocturna, that of the APOSURÆ, differs at once from all the rest of the order in the caterpillars being destitute of any anal feet, the extremity of the body terminating in a point, which in many is forked, or furnished with two long articulated appendages, forming a kind of tail. In respect to the proboscis, palpi, and antennæ, the Moths differ but little from the preceding.

Dicranoura, God. (*Cerura*, Schr., *Harpyia*, Ochs.), have the external habit of Chelonia or Sericaria, and the extremity of the body of the larva is terminated by two tails. [*C. Vinula*, the Puss Moth.]

Platypteryx, Lasp. (*Drepana*, Schr.), more resembles Phalæna, having the fore-wings hooked at the tips and the body slender; the body of the larvæ terminates in a point. In respect to the latter state, these Moths therefore resemble the Dicranouræ; but, in their perfect state, that of Phalenites. *Ph. falcataria, lacertinaria*, &c.

The fifth section of the Nocturnal Lepidoptera, that of the NOCTUÆLITES, Latr., resembles the preceding in the wings, but differs in having a corneous proboscis rolled up in a spiral direction, and mostly very long; palpi terminated suddenly by a very small joint, slenderer than the preceding, which is much larger, and very compressed. The body is generally clothed with scales rather than with wool; the thorax is often crested above, and the abdomen is of an elongate conic form; the antennæ are generally slender and simple. Their flight is very rapid, and some species fly during the day.

The caterpillars have mostly sixteen feet; some have two or four less, but the anal pair is never wanting; and in those with only twelve feet the anterior pair of the membranous legs is as large as the following. The majority of these caterpillars inclose themselves in a cocoon. They compose the section *Phalæna-Noctua*, Linn. All the generic groups established recently, and which are characterized rather from the caterpillar than the perfect state, may be reduced to the two following subgenera.

Erebus, Latr. (*Thysania*, Dalm., *Noctua*, Fab.), has the wings always extended and horizontal, and the last joint of the palpi long, slender, and naked. These are very large moths, all of which are exotic except one Spanish species.

NOCTUA,

Has the last joint of the palpi very short, and clothed with scales, like the preceding. The majority have the larvæ 16-footed, as the Red Under-wing Moths, *Noctua* [*Catocala*] *sponsa*, &c. Others have only twelve feet, and the imago is ornamented with golden or silvery spots, such as the Burnished Brass Moth, *Noctua* [*Plusia*] *Chrysites*, &c. The larvæ of some, as *N. Verbasci, Absinthii*, &c., feed on the flowers of the plants after which they are named. Others have the antennæ feathered, as *N. graminis*, the larva of which is very destructive to pastures in Sweden [and elsewhere]. This genus is divided by Ochsenheimer into forty-two genera, being for the most part equivalent to the groups proposed in the systematic catalogue of the Lepidoptera of Vienna, of which, however, the nature of our work does not allow the details. After the removal of Erebus, Latreille, in a note, suggests that the Noctuæ form two series; the first having partially geometrical larvæ, and the others having 16-footed larvæ, both, however, terminating with species conducting to Herminia and Pyralis.

Bombyx Cyllopoda, Dalm., forms a new and anomalous subgenus.

The sixth section of the Nocturnal Lepidoptera, that of the PHALÆNA TORTRIX, Linn., has the greatest relation to the preceding species, the upper wings having the outer margin curved at the base, and subsequently narrowed; and their short, broad form, like a truncated oval, gives these insects a remarkable appearance; the proboscis is distinct, and the palpi generally nearly similar to those of the Noctuæ, but rather more advanced. They are small Moths, agreeably coloured, with the wings nearly horizontal, or rather slightly deflexed at the sides; the upper pair slightly crossing the lower. The caterpillars are 16-footed, the body being generally smooth, or but slightly hairy; they roll up the leaves, fixing them by threads in a parallel direction, and thus forming them into cases, whereby they devour the parenchyme of the leaves at leisure; others make retreats by fastening several leaves or flowers together, and some reside inside fruits; some of these caterpillars have the body slender at the tip, and their cocoons are in the figure of a boat turned upside down; these cocoons are sometimes entirely of silk, and sometimes of silk mixed with other matters. They form the subgenus

PYRALIS, Fab. [*Tortrix* of English authors].

P. pomana, Fab., the Codling Moth, *P. vitis*, *P. prasinaria*, [and a great number of species, divided by more recent authors into a great number of subgenera]. Latreille in a note adds indications of the additional subgenera *Xylopoda* (*Tortrix dentaria*, Hb.), *Volucra* (*P. rutana*, *umbellana*, *Heracleana*), and *Procerata* (*P. saldonana*, Fabr.)

The seventh section of the Nocturna, that of the PHALÆNITES, Latr. (*Phal. Geometra*, Linn.), has the body generally slender, with the proboscis either wanting or but little elongate, and nearly membranous; the palpi small and subcylindric; the wings ample, extended, or like a nearly flat roof; the antennæ in many of the males are pectinated; the thorax smooth; the caterpillars have generally only ten feet; sometimes, however, they have an extra pair; the anal feet always exist. From their mode of walking, they are called Geometers, or Loopers, described above (p. 604). Their attitude of repose is singular; fixed to a branch or twig, and holding only by the hind pair of feet, the body is stretched in a straight line, and at an angle with the branch immoveably. In their colours, also, and the rugosities in their bodies, they also resemble branches: in this position they will remain for many hours, and even for entire days. The chrysalides are naked, or are inclosed in a very slender cocoon. When the caterpillars are not taken into consideration, this section only forms a single genus,—

PHALÆNA.

The caterpillar of *P. margaritaria*, Fab., the type of my subgenus *Metrocampa*, has twelve feet, but the rest only ten, such as *P. sambucaria*, the Swallow-tailed Moth, formed by Leach into the subgenus *Ourapteryx*; *P. grossulariata*, Linn., the Magpie Moth, [a very abundant species, the larva and pupa of which are figured in a preceding page. The females of *P. brumata*, and some others, have only very slight rudiments of wings. The latter species appear only in winter. One species, *P. sexalisata*, is remarkable for the males possessing a small appendage at the inner edge of the hind wing. These species form my subgenus *Hybernia*.

Fig 131.—Phalæna grossulariata.

[This is a very extensive tribe, formed into the family *Geometridæ*, and divided by recent authors into a very great number of genera.]

The eighth section of the nocturnal Lepidoptera, that of the DELTOIDES, presents to us species very nearly allied to the Phalænæ proper, but of which the caterpillars have fourteen feet, and roll up leaves. In the imago, the palpi are elongated and recurved. The wings form with the body, at the sides of which they are horizontally extended, a kind of delta, of which the posterior edge has at the middle an indented angle, or appears furcate. The Deltoid Lepidoptera form the subgenus

Herminia, Latr., belonging to the division of the *Phalæna Pyralis* of Linn., *Hyblæa* and part of *Crambus*, Fabr.

The ninth section of the Nocturna, that of the TINEITES, Latr. (*Phalæna Tinea*, Linn.), and the major part of his Pyralides, comprises the most minute species of the order, and of which the caterpillars are always furnished with sixteen feet at least, are rectigrade, and live hidden in fixed or moveable cases which they form. In some, the wings form a kind of elongated triangle, nearly flattened; such are the *Ph. Pyralides*, Linn., which have four distinct palpi, and generally exposed. In others, the upper wings are long and narrow; in all, the hind wings are always broad and folded; the four palpi of these are also often exposed.

The substances upon which the caterpillars feed, or on which they mostly dwell, provide them with materials for their cases. Among the cases formed of vegetable matters, some are very singular: the Adelæ, for instance, make their nests of bits of leaves, arranged upon each other. In some the material is transparent. The caterpillars of the true Tineæ clothe themselves in cases formed of hair, fur, &c., which they cut off with their jaws, as well as of the hair of the skins of animals, and which they fasten with silken threads. They have the instinct to elongate or widen these cases by slitting them, and introducing a new piece. They undergo their transformations in these cases, having first closed the orifice with silk. Réaumur, Rosel, and De Geer have especially investigated the habits of these insects.

Other species burrow into the interior of the vegetable and animal substances upon which they subsist, forming simple galleries, where they construct cases either of these materials or of silk; these habitations are always fixed, and serve only as retreats. Others, again, pierce the interior of leaves upon which they feed, producing dried-up patches either in spots or undulating lines, to be observed on many leaves: buds, fruits, seeds, and often grains of wheat, as well as the resinous galls of some fir trees, serve for food and abode to others.

These Moths are often ornamented with very brilliant colours, the upper wings having gold or silver spots.

Some, the Pyralides, having the four palpi always distinct, exposed, or slightly hidden by the scales of the clypeus, porrected, have their wings roof-like, but more flattened. Some of these have the proboscis very distinct, and the caterpillars live upon different plants.

Botys, Latr., has leaf-rolling caterpillars, with ordinary organs of respiration. *Phal. urticata*, Linn. [the Small Magpie Moth], the caterpillar of which feeds on the nettle.

Hydrocampe, Latr., is composed of nearly allied species, but of which the caterpillars are aquatic, with long, filamentous appendages for respiration, the interior being furnished with tracheæ. They form tubes with the leaves of aquatic plants, or are exposed.

Others have the proboscis obsolete, or nearly so.

Aglossa, Latr., has the four palpi exposed, the wings forming a flat triangle. *P. pinguinalis*, Linn., the larvæ of which feeds on grease or buttery substances. According to Linnæus, it has been found but rarely in the human stomach, where it produces more violent effects than ordinary intestinal worms. A medical man has sent me some caterpillars of this species, which had been vomited by a young female. *P. farinalis*, Linn., feeds on flour.

Galleria, Fab., has the palpi covered by the scales of the front of the head; the fore-wings narrower than in Aglossa, and notched at the hind margin, and greatly deflexed at the sides. *G. cereana*, Fab., the Honeycomb Moth, the larva of which commits much mischief in hives, by burrowing through the comb, and constructing a silken web, mixed with grains of excrement; the cocoons are sometimes found united in a mass. *G. alvearia*, Fab. [also feeds on honeycomb], but is more allied to Tinea than this genus. *Crambus erigatus*, Fabr., and *Tinea tribunella* and *colonella*, are allied to the preceding, but the palpi are longer, whence they are nearer allied to Crambus. They form several subgenera.

The others have the maxillary palpi not always distinct, the upper wings long and narrow, sometimes rolled round the body and sometimes extended perpendicularly at the sides. In this state the insect has always a narrow and elongated form, approaching that of a cylinder, or cone.

Some have the labial palpi large and porrected, the last joint at most being recurved; the maxillary palpi are distinct.

Crambus, Fab., has a distinct proboscis, and the palpi beak-like; they frequent dry pastures.

Alucita, Latr. (*Ypsolophus*, Fab.), has also the distinct proboscis, but the last joint of the palpi is recurved.

Euplocamus, Latr. (*Phycis*, Fab.), has the proboscis very short, with the last joint of the palpi recurved; the male antennæ have a double row of beards.

Phycis, Fab., similar to Euplocami, but with the antennæ only ciliated. Others have the labial palpi entirely recurved over the head in many. In the two following subgenera the palpi scarcely extend beyond the forehead.

Tinea, has the proboscis short, formed of two membranous filaments; the head is very hairy. *P. tapezana*, Fab., the larva of which gnaws clothes and other stuff materials, concealed in a case formed of particles of these substances, which it gnaws off.

Other species, *T. sarcitella*, F., *pellionella*, Fab., *flavifrontella* and *granella*, feed on clothes, woollen stuffs, furs, objects of natural history, and grains of wheat in granaries.

Ilythia, Latr. (*Crambus*, Fab.), has the proboscis distinct, and of the ordinary size, and the last joint of the palpi shorter than the preceding.

Yponomeuta, Latr., has the proboscis distinct, and the last joint of the palpi as long as the preceding joint. These insects are allied to *Lithosia*, *T. evonymella* (the Small Ermine Moth), and *T. padella*, the last of which lives upon fruit-trees, in vast numbers, the larvæ covering the branches with webs.

Œcophora, Latr., has the palpi extending over the head as far as the middle of the thorax. The Corn Moth belongs to this genus, as well as *T. Harrisella*, the larva of which forms a kind of hamoc.

Adela, Latr., differs from the preceding in the very small and pilose palpi, the very long antennæ, and the eyes contiguous. The species are found in wood, and appear as soon as the oak leaves expand. The wings are generally

very orilliant. [They are called Japan-Moths.] *A. De Geerella, Reaumurella*, &c. [The former figured in the plate of Moths in the *Entomologist's Text Book*.]

The tenth and last section of the Nocturnal Lepidoptera, that of the PTEROPHORITES, has great affinity with the preceding in the narrow form and length of the body and wings, but differs in having the wings slit through their whole length, like branches, or bearded fingers, like feathers. Their wings thus imitate those of birds. Linnæus united them in his division of *Phalæna Alucita*. De Geer named them *Phalænæ-Tipulæ*.

We form them, with Fabricius and Geoffroy, into the subgenus *Pterophorus*, the caterpillars of which have sixteen feet, and feed on leaves and flowers, and do not form a case. The palpi are recurved from the base, and not longer than the head; the chrysalides are naked, setose, or tubercular. *P. pentadactylus*, Linn., the White Plumed Moth. A very common species.

Orneodes, Latr., has the palpi advanced, longer than the head, and the chrysalis is inclosed in a silken cocoon, *P hexadactylus*, Linn., &c.

THE ELEVENTH ORDER OF INSECTS,—

THE RHIPIPTERA,—

Previously established by Mr. Kirby under the name of *Strepsiptera* (or Twisted Wings), [and which has been fully proved by recent observations to have been correctly named, and that Latreille's name, Rhipiptera, ought no longer to be applied to it], is composed of some very singular insects, anomalous both in their structure and habits.

At the sides of the anterior extremity of the thorax, near the neck, and at the outer base of the two fore-legs [but in reality originating upon the very short and collar-like mesothorax], are attached a pair of small, crustaceous, moveable organs, like small elytra, bent backwards, narrow, elongated, clubbed, and curved at the tip, and terminating at the origin of the wings. [Latreille then contends that these pre-balancers are not representatives of the elytra, but of the pieces termed *ptergodes*, observed at the base of the wings of the Lepidoptera; but it has been proved that they are the real representatives of elytra.] The wings of the Rhipiptera are large, membranous, divided by longitudinal nervures, and folding lengthwise, like a fan. The mouth is composed of four pieces, of which two are short, and appear like a pair of two-jointed palpi; and the other two are inserted near the inner base of the preceding, in the form of small linear plates, pointed, and crossing each other at the tip, like the mandibles of many insects; they more nearly resemble the lancets of the mouth of some Diptera than true mandibles. According to Savigny, the mouth is composed of a labrum, two mandibles, two maxillæ, each supporting a pair of small exarticulate palpi, and of a lower lip without palpi.] The head is further furnished with a pair of large hemispherical eyes, somewhat pedunculated; two antennæ, approximating at the base on a common elevation, nearly filiform, short, and composed of three joints, the two first being very short and the third very long, divided from its base into two long compressed branches, which are applied against each other. The ocelli are wanting. The thorax [supposed by Latreille to bear] in its form and divisions much resemblance to that of many *Cicadæ*, *Psylla*, and *Chrysis*, [is now shown to be quite anomalous in its structure, consisting of a ring-like pro- and meso-thorax, and an immense metathorax]; the abdomen is subcylindric, 8- or 9-jointed, and terminated by appendages analogous to those of the above-mentioned Hemiptera. The legs, six in number, are nearly membranous, compressed, of nearly equal size, and terminated by filiform tarsi composed of four membranous joints, vesiculose at their tips, the last being rather larger than the others, without terminal ungues. The four fore-legs are close together, but the two others are placed far

behind, the space between them being very ample, and divided by a longitudinal impression in the middle. The posterior extremity of the metathorax is prolonged into a large scutellum over the abdomen.

These insects live in the larva state between the scales of the abdomen of some Andrenæ and Wasps, belonging to the subgenus *Polistes.* They move their prebalancers at the same time as their wings. Although apparently far removed, in many respects, from the Hymenoptera, I nevertheless consider them nearest allied to some of these insects, such as the *Eulophi.*

M. Peck has observed the larvæ of *Xenos Peckii,* which is found in Wasps; it is oval-oblong, without feet, annulated, with the anterior extremity dilated into a head, and the mouth formed of three tubercles. These larvæ are transformed to pupæ in the same situation, and beneath their own skin, as it appears to me from an examination of *Xenos Rossii,* and without changing its form. (See the memoir of M. Jurine upon this insect.) Probably the two prebalancers are serviceable in enabling the insect to disengage itself from between the scales of the abdomen of the insects in which they have lived.

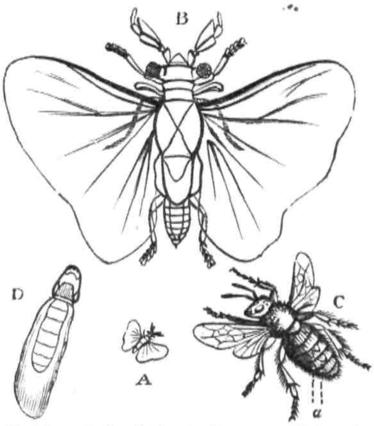

Fig. 130.—A, Stylops Dalii, nat. size; B, magnified; C, Andrena, with the heads of two of its larvæ exserted between the abdominal rings *a*; D, larva extracted and magnified

They are a kind of Œstri of insects. We shall subsequently see that a species of Conops undergoes its changes in the interior of the abdomen of *Bombi.*

They compose [four genera] *Xenos,* Rossi; *Stylops,* Kirby [and *Elenchus* and *Halictophagus,* Curtis]. They chiefly vary in the form of the antennæ. The species of the first-named genus live in Wasps, and those of Stylops in *Andrenæ.* See on these insects the memoir of Kirby, in the eleventh volume of the *Linnæan Transactions;* [also the work of Curtis, and several memoirs which I have published in the *Entomological Transactions*].

THE TWELFTH ORDER OF INSECTS,—

THE DIPTERA (ANTLIATA, Fab.),—

Has for its characters six feet, two membranous extended wings, having almost always beneath them two moveable slender bodies named halteres, or balancers, (which Latreille, in a note, endeavours to prove cannot be the representatives of hind wings, but rather of a pair of spines observed in the metathorax of some Hymenoptera, such as *Cryptocerus*). The sucker is composed of scaly, setiform pieces, of variable number (from two to six), and either inclosed in a canal on the upper side of the proboscis, which is terminated by two fleshy lip-like lobes, or covered by one or two inarticulated plates, which serve it for a sheath.

The body is composed, as in other hexapod insects, of three principal pieces; the ocelli, when present, are [almost] always three in number, [two in some Tipulidæ]. The antennæ are ordinarily inserted on the forehead; those of our first family have much relation, both in their form, composition, and appendages, with those of the Nocturnal Lepidoptera, but in the

following families they are only composed of two or three joints, the last of which is generally fusiform or lenticular, with a small styliform appendage, or hair, either simple or bearded. The mouth is only fit for extracting and drawing forth fluid matters, and when these are inclosed in proper vessels, with an envelope easily pierced, the pieces of the sucker act as lancets, piercing this envelope, and forming a passage for the liquid, which ascends by the pressure of these lancets together, to the pharynx, situated at the base of the sucker, the sheath of which serves only as a defence to these lancets, and is generally folded upon itself in their action. This sheath appears to represent the lower lip of masticatory insects, and the setæ, at least in those with the most complicated mouth, represent the other parts, such as the labrum, mandibles, and maxillæ. The clypeus, or epistome as I call it, is represented by the basal part of the proboscis preceding the sucker and palpi; the base of the proboscis mostly bears two filiform or clavate palpi, composed in some of five joints, but in most of only two. The wings are simply veined, and generally horizontal. As in the Hymenoptera, their veins furnish good secondary characters of groups.

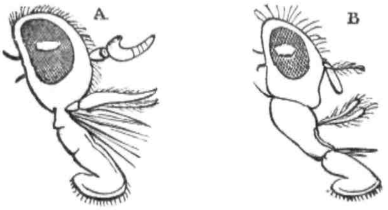

Fig. 131.—A, head of Tabanus; B, head of Musca.

The use of the balancers is not known; the insect moves them with great rapidity. Many species, especially those of the terminal families, have above the balancers two membranous pieces, like the two valves of a shell, attached together at one side, and which are termed alulets. One of these pieces is united to the wing, and partakes of its movements, at which time the two valves are upon the same plane. The size of these winglets is in inverse proportion to that of the halteres; the prothorax is always very short, and often its lateral portions are alone visible. In some species of *Scenopinus*, *Culicidæ*, and *Psychoda*, they are very prominent, like tubercles. The mesothorax alone occupies the greatest part of the thorax; in front of which, on each side, and behind the prothorax, are two spiracles, and two others are observed near the base of the balancers. As in the Hymenoptera, those of the mesothorax are hidden or obliterated.

The abdomen is attached to the thorax only by a portion of its transverse diameter; it consists of from five to nine segments, and is generally terminated by a point in the females: in those which have it composed of the smallest number of joints the terminal ones often form a kind of ovipositor, composed of tubular pieces, entering into each other like those of a telescope. The male sexual organs are external in many species, and curved beneath the abdomen. The legs, which are long and narrow in the majority, are terminated by a 5-jointed tarsus with two ungues, and often with two or three vesicular pulvilli. Many of these insects do us much damage, either in sucking our own blood or that of our domestic animals, by depositing their eggs upon their bodies, so that their larvæ may there obtain nourishment; or by infecting our viands and cereal plants with the same intention. Others, in return, are useful, by devouring obnoxious insects, consuming dead carcases, or other decaying animal matter, which would otherwise render the air we breathe impure, as well as by hastening the decomposition of putrid water.

The duration of the life of dipterous insects arrived at the final state is very short. They all undergo a complete metamorphosis, but modified in two material ways. The larvæ of many change their skin in order to undergo their transformation to pupæ, and some spin a cocoon; but the others do not moult; their skin hardens, contracts, and generally shortens, becoming a strong cocoon, of an egg-like form, for the inclosed pupa. The body of the larva is detached, leaving its own proper organs attached to the skin within, such as the parts of the mouth, &c.: shortly afterwards the inclosed insect assumes the form of a soft and gelatinous mass, without any of the parts of the future insect being visible; some days afterwards, how-

ever, these organs become distinct, and the insect has then assumed the real state of pupa [inclosed within its old skin]. It scales off the anterior extremity of its cocoon, like a cap, when it makes its escape.

The larvæ of dipterous insects are destitute of feet, but some possess appendages which resemble them. This is the only order in which the head is soft and variable; but this character is confined to such as are transformed beneath their own skin. The mouth is generally furnished with two hooks, which serve them to gnaw their food. The principal organs of respiration in the majority of the larvæ of this order are placed at the posterior extremity of the body; many have also a pair on the segment immediately behind the head.

Messrs. Fallen, Meigen, Wiedemann, and Macquart, have lately rendered signal service by the establishment of numerous generic groups, by the description of many new species, or by correcting the synonomy of those previously described. They have also employed the characters founded upon the arrangement of the nerves of the wings which I first used in my "Genera." [Latreille here overlooks the previous claims of Harris.]

The work of Macquart upon the Diptera of the north of France appears to me to be the best treatise yet published on these insects. [M. Macquart has lately published a general classification of the order, in two volumes, in the *Suites de Buffon*, as well as a distinct work on Exotic Diptera. Messrs. Haliday and Walker have added much to our knowledge of British Diptera.]

We divide this order into two principal sections, which form distinct orders in the works of [several] English authors.

The Diptera of the first section have the head always distinct from the thorax, the sucker inclosed in a sheath, and the tarsal claws simple, or unidentate. The transformation of these insects from the larva to the pupa state never takes place within the abdomen of the parent fly.

A first subdivision is composed of Diptera having the antennæ divided into a great number of joints; they form

THE FIRST FAMILY OF THE DIPTERA,—

THE NEMOCERA,—

The antennæ of which are mostly composed of from fourteen to sixteen joints, or from six or nine to twelve in others. They are filiform or setaceous, often villose, especially in the males, and much longer than the head. The body is elongated, with the head small and rounded; the eyes large; the proboscis exserted, short, and terminated by two large lips, or prolonged into a beak; two external palpi inserted at its base, generally filiform or setaceous, and composed of four or five joints; the thorax thick, elevated, and gibbose; the wings oblong; the balancers entirely exposed, and not accompanied by large alulets; the abdomen elongated, mostly formed of nine segments terminated in a point in the females, thicker at the tip, and armed with hooks in the males; the legs very long and slender, and often enabling these insects to balance themselves.

Many of the smaller species assemble in great troops in the air, where they form a sort of dance. They are found at almost all seasons of the year. Many deposit their eggs in the water; others in the earth, or upon plants.

The larvæ, always elongated and worm-like, have a scaly head, of a constant form, and the mouth is furnished with parts analogous to maxillæ, and lips. They always shed their skins on assuming the pupa state. These pupæ, which are sometimes naked and sometimes inclosed in cocoons spun by the larva, approach the perfect insects in their figure, being furnished with external organs, and undergoing their transformations in the ordinary manner. They have often near the head and thorax two respiratory organs, in the form of tubes, or ears.

This family is composed of the genera *Culex* and *Tipula* of Linnæus.

Some have the antennæ always filiform, as long as the thorax, thickly clothed with hairs, and

composed of fourteen joints; and the proboscis is long, porrected, filiform, inclosing a punctorial sucker, composed of five setæ, [according to Latreille, but in reality of six, exclusive of the palpi].

They constitute the genus

CULEX, Linn. (*Culicides*, Latr.),—

And have the body and legs very long, the antennæ very hairy, forming a thick pencil, in the males; the eyes large, convergent above; the palpi porrected, filiform, villose, as long as the proboscis, and 5-jointed in the males, shorter and fewer-jointed in the females; the proboscis is composed of a membranous cylindrical tube, terminated by two lips, forming a kind of knob, and of a sucker consisting of five [six] scaly filaments, producing the effect of a sting, the wings resting horizontally upon the back, with small scales.

These insects are very annoying, especially in damp situations, where they most abound. Thirsting for our blood, they pursue us every where, entering our habitations, especially in the evening, making a loud buzzing, and piercing our skins, which our clothes cannot even always protect, with the delicate setæ of their proboscis, which are denticulated at the tips. In proportion as they thrust it into our flesh the sheath of the proboscis becomes elbowed towards the breast. They discharge a venomous fluid into the wound, which is the cause of the pain felt. It is observed that we are only attacked by the female gnats; [the males indeed have the mouth organs, fewer in number and weaker]. The gnats are known in America under the names of Maringouins or Musquitoes. They are only to be guarded against by enveloping the bed with a Musquito curtain. The Laplanders drive them away by fire, and by coating the naked parts of the body with grease. The females deposit their eggs on the surface of the water, crossing their hind legs near the anus, and by degrees extending them as the eggs are discharged from the body, and which they place side by side, the entire mass resembling a small boat: each female deposits about 300 eggs in the course of the year. These insects are able to withstand the strongest frosts. The larvæ live in stagnant water, and are especially to be found in the spring. They suspend themselves at the surface of water, head downwards for respiration; they have a distinct rounded head, furnished with a pair of antennæ, and of ciliated organs, which serve by their continual motion to form a kind of current, which brings their food to the mouth; a thorax with bundles of hairs; an elongated, nearly cylindric abdomen, much narrower than the anterior part of the body, 10-jointed, the antepenultimate joint being furnished with a respiratory organ on its back; the terminal joint is also terminated by setæ and by radiating pieces. These larvæ are very active, swimming with great agility, often descending, but quickly coming again to the surface of the water. After having undergone several moultings, they are transformed into pupæ, which continue moveable with the assistance of their tails and two oar-like pieces at its extremity. They also suspend themselves at the surface of the water, but in a contrary direction to that of the larva; the organs of respiration being now placed at the thorax, and consisting in a pair of tubular horns. It is then also that the imago is developed, the exuviæ of the pupa becoming a kind of raft for it, which preserves it from submersion. All these changes are effected [in the summer], in three or four weeks, so that there are several generations in the course of the year.

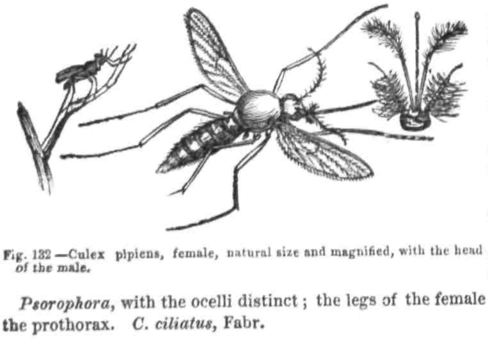

Fig. 132.—Culex pipiens, female, natural size and magnified, with the head of the male.

Culex proper, comprises those species which have the male palpi longer than the proboscis, and very short in the females. *C. pipiens*, Linn., the Common Gnat.

Anopheles, Meg., has the male palpi as long as the proboscis.

Ædes, Hoffm., has the palpi in both sexes very short. Robineau Desvoidy, in his essay on this family, has added three other genera.

Sabethes, with the palpi shorter than the proboscis, and the middle tibiæ and tarsi dilated.

Megarhina, with the proboscis long and recurved at the tip; the palpi short, with the basal joint thick.

Psorophora, with the ocelli distinct; the legs of the female ciliated, and two small appendages at the sides of the prothorax. *C. ciliatus*, Fabr.

The other Nemocera have the proboscis either very short, and terminated by two large lips, or like

a perpendicular or incurved beak; the palpi are curved under, or recurved, but in the latter case they have not more than two joints. Linnæus united them in his genus

TIPULA (*Tipulariæ*, Latr.),

Which we divide in the following manner:—

A first section is composed of species with antennæ longer than the head, at least in the males, slender, filiform, or setaceous, more than 12-jointed in the majority, and with long and slender feet.

Some, having always wings, are destitute of ocelli, the palpi always short, the head scarcely prolonged in front, the wings horizontal or roof-like, with but few nerves; the eyes crescent-like, and the tibiæ not spined. These are small species which reside, in the early states, either in water or in the galls of vegetables.

The *Tipulides Culiciformes* resemble Gnats, having the antennæ entirely pilose, but with the hairs much longer in the males than in the females. Their larvæ live in the water, and resemble those of Gnats. Some of them have false feet; others have arm-like appendages at the posterior extremity of the body; they are generally of a red colour. The pupæ are also aquatic, and respire by two outer appendages placed at the anterior extremity of the body. Some have the power of swimming.

Corethra, Meg., has the antennæ composed of fourteen oval joints, the terminal ones scarcely differing from the preceding, and the wings horizontal. *T. culiciformis*, De Geer [the Straw-coloured Midge].

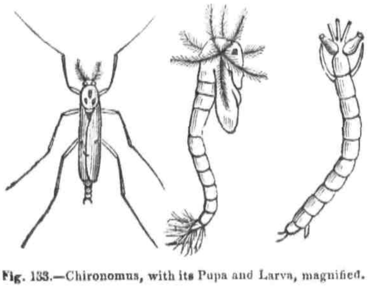

Fig. 133.—Chironomus, with its Pupa and Larva, magnified.

Chironomus, Meig., has the wings inclined, the antennæ 13-jointed in the males, and 6-jointed in the females, with short hairs, the last joint, as in the males, being very long. *T. annulata*, De Geer, [a very numerous genus of Midges].

Tanypus, Meig., has the wings also deflexed, but the antennæ are 14-jointed in both sexes; the penultimate joint very long in the males; the rest, as also all the joints of the female antennæ, nearly globular; the larvæ have four false feet,—two near the head, and two at the extremity of the body.

The *Tipules Gallicoles* have the antennæ composed in both sexes of at least thirteen joints, furnished in the majority with short hairs; at the most with a pencil of hairs at the base in some males.

Ceratopogon, Meig. (*Culicoides*, Latr.), has a bundle of hairs at the base in the males; the proboscis, as in the two following subgenera, has the form of a pointed beak; the wings are incumbent on the body, and their larvæ live in vegetable galls.

Psychoda, Latr., has no brush or hairs to the antennæ; the wings are roofed, and have a great number of nerves; one species has two appendages at the side of the thorax, which appear to be formed by the lateral extremities of its front segment.

Cecidomyia, Meig., has the antennæ, as in Psychoda, moniliform, and furnished with verticillated hairs; the wings horizontal on the body, with only three nerves.

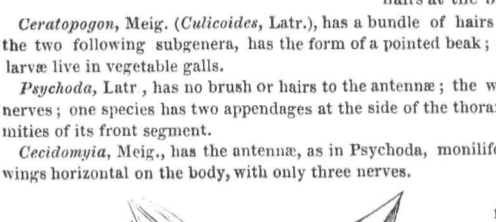

Fig. 134.—Cecidomyia destructor, and C. Tritici, with the larvæ of the latter feeding in wheat flowers, magnified.

Lestremia, Macquart, has the antennæ formed of five globular, pedunculated joints in the males, the legs long and slender, and the basal joint of the tarsi long. *C. destructor*, Say, appears to belong to this subgenus.

Macropeza, Meg., is also closely allied to these insects.

The *Tipules Terricoles* comprise the largest species in the family, with the antennæ longer than the head, and slender; destitute of ocelli; the eyes round and entire; the wings, extended in many, have always membranous nerves, united together transversely, and closed discoidal cells. The front of the head is narrowed, and prolonged into a muzzle, with a basal prominence; the palpi generally long, and the extremity of the tibiæ spinose.

The larvæ of many species live in the earth, the rotten parts of trees, &c. The thorax is not distinct, and they have no false feet. They exhibit at the superior extremity of the body two more evident apertures for respiration. The pupæ are naked, with two respiratory tubes near the head; and the edges of the abdominal segments spinose. These insects are well known under the name of *Daddy Long-legs*, *Tailors*, &c.

In many, the wings are always extended, and the palpi long; with the last joint very long and annular.

Ctenophora, Meig., has filiform antennæ, pectinated in the males, and serrated in the females. *Tipula pectinicornis*, Fabr.

Pedicia, has them nearly setaceous, simple, with the two basal joints thicker, and the seven terminal ones slender and subcylindric.

Tipula, Latr., has also the antennæ nearly setaceous and simple; but all the joints, except the second, are nearly cylindric; the first is largest, the third elongate. *T. oleracea*, the Common Crane Fly, or Daddy Long Legs, very common in pastures; the larva feeds on the roots of dying plants, [and many other species].

Nephrotoma, Meig., has 19-jointed antennæ in the males, and fifteen joints in the females, the third and following being arched.

Ptychoptera, Meig., has simple sub-setaceous antennæ, 16-jointed; the third much longer than the others, and the following oblong.

In the following, the terminal joint of the palpi is scarcely longer than the others, and presents no appearance of annuli; and the wings are often incumbent on each other. Some of these have more than 10-jointed antennæ.

Rhipidia, Meig., has the male antennæ pectinated.

Erioptera, Meig., has, like the preceding, many nerves, but they are pilose.

Lasioptera, Meig., has the wings villose, but only with two nervures.

Limnobia, Meig., has the wings glabrous, and the antennæ simple in both sexes.

Polymera, Weid., has 28-jointed antennæ.

Trichocera, Meig., has the basal joints of the antennæ oval, and the terminal ones very slender, long, and pubescent. *T. hiemalis*, the Winter Midge.

Macropeza, Meig., has the hind feet exceedingly long; the basal parts of the antennæ are hairy.

Dixa, Meig., appears allied to Trichocera, but the basal joint of the antennæ is very short, second nearly globular, and the following more slender.

Megistocera, Weid., has only 10-jointed antennæ.

Hexatoma, Latr., has 6-jointed antennæ, and consists of the *Anisomeræ* and *Nematoceræ* of Meigen, the first of which has the third joint of the antennæ much longer than the second.

Chionea, Dalm., differs from all the rest in wanting wings; the abdomen of the females is terminated by a bivalve ovipositor; the eyes are rounded, and the ocelli obsolete. The only species [known to Latreille] is found in winter on the snow. *C. araneoides*, Dalm.

The *Tipule atome* of De Geer forms another apterous subgenus, but the antennæ have at least fifteen joints. It, as well as the preceding, is very small.

Another division, the ***Tipules fungivores***, is distinguished by possessing two or three ocelli; the antennæ, much longer than the head, slender, 15- or 16-jointed; the eyes entire, or notched; the last joint of the palpi not articulated; the wings horizontal, with much fewer nervures than in the preceding; the legs long and slender, with the tips of the tibiæ spinose; some have the palpi curved, and composed of four joints.

Rhyphus, Latr., has the eyes entirely occupying the head; the ocelli of equal size, and the muzzle advanced, and not longer than the head.

Asindulum, has the eyes occupying only the sides of the head, and the muzzle prolonged beneath the breast.

Gnoriste, Meig., differs from the last only in having the palpi apparently inserted near the tip of the proboscis.

In the following, the head is not produced into a muzzle.

Bolitophila, has long antennæ, and the eyes arranged in a transverse line. Guérin has published a complete memoir on a species of this genus.

Macrocera, Meig., has the male antennæ very long, and the ocelli arranged in a triangle.

In the rest, the antennæ are never longer than the head and thorax

Mycetophila, Meig., has spined hind tibiæ, and only two ocelli.

Leia, Meig., differs from Mycetophila in having three ocelli; the front one being very small.

Sciophila, Meig., has the joints of the antennæ more distinct; and a small cubital cell.

Amongst the subgenera with simple tibiæ, and three ocelli close together, some have 16-jointed antennæ, and the eyes entire.

Platyura, Meig., approaches Sciophila, but the first cubital cell is much larger; the abdomen of the females is broader behind.

Synapha, Meig., has only a single cubital cell, closed by the hind margin of the wing; the middle discoidal cell is furcate in the middle, forming a closed oval cell.

Others have the eyes notched in the inside.

Mycetobia, Meig., has 16-jointed antennæ, and the wings have a large closed cell, extending from the base to the middle.

Molobrus, Latr. (*Sciara*, Meig.), has similar antennæ, and the middle of the wing exhibits a cell, extending from the base to the hind margin, and closed only by this margin.

Campylomyza, Wied., has only 14-jointed antennæ, at least in the females; the inner portion of the wings has no nervures: and the eyes are entire.

Ceroplatus, Bosc., has the palpi apparently composed of a single joint, and the antennæ fusiform and compressed.

Our last general division of the Tipulaires, is the *T. florales*, consisting of species having the antennæ scarcely longer than the head in both sexes, thick, and 8- or 10-jointed, forming a perfoliated mass; nearly cylindric in the majority, but fusiform in others, or terminated by a large joint; the body is short and thick; the head is generally almost entirely occupied by the eyes in the males. From the nervures of the wings and palpi, these Diptera approach the *Tipulaires fungivores*.

Cordyla, Meig., differs from all the rest in having 12-jointed antennæ; the eyes are round, entire, and apart, and the ocelli wanting; the legs are long, and spiny at the tips of the tibiæ. The others have 11-jointed antennæ, and the eyes of the males very large.

Simulium, Latr. (*Culex*, Linn.), has no ocelli, and the eyes of the females are internally notched, and crescent-shaped. The species are very small, frequenting damp places, and are very troublesome, from their biting, or rather pricking the flesh; they also sometimes penetrate into the generative parts of cattle, and kill them. Like some of the Culicidæ, they are also called Musquitoes.

In the others, there are three ocelli.

Scatopse, Geoff., approaches the last in having the eyes emarginate, but differs from all in having the palpi very small, and apparently composed of but a single joint. *T. latrinarum*, De Geer, a small fly, commonly found in privies.

Penthetria, Meig., has the eyes entire, and separate in the two sexes; the legs are long, and not spinose.

Dilophus, Meig. (*Hirtæa*, Fabr.), has the eyes contiguous in the males, often occupying almost the whole of the head; the tips of the tibiæ have a coronet of spines.

Bibio, Geoff. (*Hirtæa*, Fabr.), has 9-jointed antennæ, forming a perfoliated mass. The species are very sluggish, flying but little. Some of them are very common in gardens; the two sexes often differ greatly in appearance and colours. *Tip. hortulana*, Linn. Their larvæ live in dung, earth, and manure, and have small rows of spurs on the segments of the body. The pupæ are not inclosed in cocoons.

Aspistes, Hoffm., has only 8-jointed antennæ; the last joint forming an ovoid mass.

All the following Diptera (a very small number excepted), have the antennæ composed [at first sight] of only three joints, the first of which is sometimes so short, that it is scarcely to be reckoned as such; the last is in many transversely annulated, but without distinct separations. It is often accompanied by a seta, generally lateral, or placed at the top of the joint in others; having at its base one or two joints, and sometimes simple, sometimes hairy. If this seta is terminal, it happens in many that its length diminishes and its thickness increases, forming a kind of style. Although this style is, in effect, a continuation of the antennæ, it would create confusion in the nomenclature by adding the number of its joints to that of the ordinary joints of the antennæ. The palpi have never more than two joints. Some of these (a small number excepted) cast their larva-skin on becoming pupæ, and have the sucker composed of six or four pieces; the proboscis, or at least its lips, is always exserted; the palpi, when present, are external, and inserted near the margins of the oral cavities, and the sucker arises near this cavity. The larva, in those which retain the larva skin, serves as a cocoon for the pupa, without changing its primitive form. This subdivision comprises three families, [*Tanystoma*, *Notacantha*, and *Athericera*].

THE SECOND FAMILY OF THE DIPTERA,—

THE TANYSTOMA,—

Is distinguished by having the last joint of the antennæ (not reckoning the style), not transversely annulated, and the sucker consists of four pieces.

Their larvæ resemble long worms, nearly cylindric, and without feet, with a scaly head of constant form, always furnished with hooks or retractile appendages, which serve them for gnawing or sucking the substances on which they subsist. The majority live in the earth, and change their skin on assuming the pupa state. The pupæ are naked, and exhibit many of the external parts of the imago, which escapes from its exuviæ by a slit down the back.

A first division comprises those Diptera which have the proboscis always entirely, or almost entirely, exserted, with the sheath of a rather solid, nearly horny consistence, being more or less porrected, and either cylindric, conic, or filiform, terminating without any marked dilatation; the palpi are small.

Some of these live by rapine, and have the body oblong, with the thorax narrow in front; the wings incumbent on the body; the proboscis short, or but slightly elongated, and forming a kind of beak; the antennæ are close together, and the palpi exposed.

ASILUS, Linn.,—

Has the proboscis porrected in front. They make a buzzing noise whilst flying, and seize Flies, Tipulæ, Humble-bees, and even Beetles, which they suck. Their larvæ live in the earth, having a scaly head armed with two moveable hooks, and being there transformed into pupæ, which have hooked teeth on the thorax, and small rows of spines on the abdominal segments.

A first subdivision, ASILICI, Latr., has the head transverse; the eyes lateral and wide apart, even in the males; the proboscis at least as long as the head, and one complete cell, of an elongated triangular form, near the inner margin of the wing, and terminating at the hind margin. The epistome is always bearded.

Some of these (with two pulvilli, and two ungues at the tips of the tarsi) have the antennæ scarcely longer than the head; the style scarcely distinct, or very short.

Laphria, Meig., has the style not at all, or scarcely visible, and the proboscis straight. [Numerous handsome exotic species.]

Ancilorhynchus, Latr., has the style scarcely exserted, and pointed, and the proboscis like a compressed, curved and hooked beak.

Dasypogon, has the style distinct and conical, and the proboscis straight.

In the two next subgenera the antennæ are evidently longer than the head.

Ceraturgus, Wied., has the antennæ not arising on a peduncle.

Dioctria, Meig., has them inserted on a common peduncle.

In others, the style at the tip of the antennæ is prolonged like a seta.

Asilus proper, has the style simple. The species are very numerous. *A. crabroniformis* [the largest British species], is not uncommon at the end of summer in sandy places. The transformations of *A. forcipatus* have been observed.

Cyrtoma, Meig., differs from all the rest in having 2-jointed antennæ, the palpi resting on the proboscis, the conic-elongate form of the last joint of the antennæ, and the smallness of the palpi.

Ommatius, Illig., differs from all the foregoing in having the style of the antennæ plumose.

Gonypus, Latr. (*Leptogaster*, Meig.), has three ungues at the tips of the tarsi, the middle one replacing the two pulvilli.

The second subdivision, HYBOTINI, Latr., has the head rounder, nearly occupied by the eyes in the males, with the clypeus rarely bearded; the proboscis is very short; the wings have fewer nerves than the preceding insects, and their inner portion does not exhibit the complete triangular cell, or it is only rudimental.

Œdalea, Meig., has the last joint of the antennæ large, elongate-fusiform, and terminated by a very small style.

Hybos, Meig. (*Damalis*, Fab.), (with thick hind-thighs), and

Ocydromia, Hoffm. (with the hind-thighs of ordinary size), have the last joint of the antennæ short, ovoid, or conic, with a long seta.

Microphora, Meig., has the third joint of the antennæ, as well as the style, long.

Lemtopeza, nearly allied to Ocydromia, but with the style terminal, and not dorsal.

EMPIS, Linn. (*Empides*, Latr.),—

Are closely allied to Asilus in the form of the body and position of the wings, but with the proboscis perpendicular, or directed backwards. The head is rounded, nearly globular, with the eyes greatly extended. The species are of small size; live by rapine and on the honey of flowers. The last joint of the antennæ is always terminated by a short biarticulate style, or by a seta. The males of some species have the basal joint of the fore-tarsi very dilated.

Some have 3-jointed antennæ, of which the last is sometimes in the form of an elongate cone.

Empis proper, has the proboscis much longer than the head, the bi-articulate style at the tip of the antennæ being always short; the palpi always recurved. *Empis pennipes*, Fab., remarkable for the hind legs of the females being very hairy.

Ramphomyia, Meig., differs from Empis in wanting the small transverse nerve at the tips of the wings.

In the following, the proboscis is scarcely longer than the head.

Hilara, Meig., has the antennæ terminated by a small 2-jointed style. In

Brachystoma, Meig., they are terminated by a long seta.

Gloma, Meig., differs from the preceding in having the last joint of the antennæ terminated by a seta, and forming, with the preceding joint, a spherical body.

The rest have only two distinct joints in the antennæ, the last joint being ovoid or subglobose, and terminated by a seta, forming the second joint of the style. The proboscis is generally short, with the palpi resting upon it.

Hemerodromia, Hoffm., has the two fore coxæ very long.

Sicus, Latr. (*Tachydromia*, Meig.), has the first or second pair of thighs thickened.

Drapetis, Meig., has the last joint of the antennæ subglobose, and the proboscis scarcely exserted.

M. Macquart [as well as Mr. Haliday and Professor Zetterstedt] have established several additional genera, which it would occupy too much space to notice in detail.

The other Tanystoma of our first division have the body generally short, broad, with the head exactly applied to the thorax; the wings extended, and the abdomen triangular. They have, in a word, the appearance of Domestic Flies. The proboscis is often very long.

CYRTUS, Latr. [*Vesiculosa*, Latr.],—

Intermediate between Empis and Bombylius, with the wings deflexed at each side of the body; the alulets very large, and covering the balancers; the head small and globular; the thorax very gibbose; the abdomen vesiculose, and the proboscis directed backwards, or wanting.

Some have a proboscis directed backwards.

Panops, Lam., with antennæ longer than the head, cylindric, and 3-jointed, without a terminal seta.

Cyrtus proper, with antennæ very small, 2-jointed, with a seta at the tip.

The others have not an extraordinary proboscis.

Astomella, Duf., has the antennæ 3-jointed, with the last joint forming a compressed, elongated knob, without a seta.

Henops, Illig. (*Ogcodes*, Latr.), has antennæ inserted before the eyes, small, and 2-jointed, with a terminal seta.

Acrocera, Meig., differs in having the antennæ inserted behind the eyes.

BOMBYLIUS, Linn. (*Bombyliers*, Latr.),—

Has the wings extended horizontally on each side of the body, with the balancers naked; the thorax higher than the head, or gibbose, as in Cyrtus; the antennæ close together, and the abdomen triangular, or conical. The proboscis is porrected in front, and very long in many species. The antennæ are always 3-jointed, the last being elongated, compressed, fusiform, generally terminated by a very short style, and never by an elongated seta. The palpi are slender, filiform; the legs are long and slender. These insects fly with wonderful rapidity, hovering over flowers without settling, and introducing their long proboscis in order to suck up the honey, and making a sharp buzzing noise. I suppose that their larvæ, like those of Anthrax, are parasites.

Some have the proboscis evidently longer than the head, very slender, and pointed at the tip.

Toxophora, Meig., has the antennæ as long as the head and thorax, filiform, pointed at the tip, and the body elongated.

Xestomyza, Wied., has shorter antennæ, but the first joint is elongated, and longer than the other joints, and fusiform, as is also the third.

Apatomyza, Wied., has the first joint also very long, but cylindrical. In the subsequent subgenera the last joint [of the antennæ] is the longest, and sometimes the two basal joints of the antennæ are short, and of nearly equal length.

Lasius, Wied., has the head nearly occupied in one sex by the eyes, and the last joint of the antennæ very long, nearly linear, compressed, and without a terminal style; the abdomen is voluminous; the proboscis occasionally extends beneath and beyond the extremity of the body, which seems to connect this genus with [Cyrtus or] the tribe of *Vesiculosæ*.

Usia, Latr., has the last joint of the antennæ ovoid, conic, obtuse, or truncated at the tip, and terminated by a style; the palpi not apparent. [South of Europe, or Africa.]

Phthiria, Meig., resembles Usia in the antennæ, but with distinct palpi; sometimes the second joint is evidently shorter than the first; the last is long, generally almost cylindric, and pointed at the tip.

Bombylius proper, has very distinct palpi, and the body is clothed with a thick woolly coating of hairs. *B. major*, Linn., a very abundant species [in this country].

Geron, Meig., has the last joint of the antennæ longer, terminating like an awl, and the wings wanting one of the transverse nerves near the hind margin.

Thlipsomyza, Wied., is allied to the preceding, and Phthiria; and I presume that

Amictus, Wied., also approaches them. Both have the basal joint of the antennæ longer than the second, and cylindrical; the wings of Amictus, however, differ from the preceding subgenera.

The other species have the proboscis not longer than the head, and thickened at the tip, and the basal joint of the antennæ is the largest.

Ploas, Latr. (*Conophorus*, Meig.), has this joint much thicker than the rest.

Cyllenia, has this joint merely longer, but not thicker, and the abdomen is more elongated, and nearly conical.

ANTHRAX, Scop. (*Anthracii*, Latr.),—

Similar to the Bombylii, with the body depressed, or but slightly elevated above; not gibbose, with the head as high and broad as the thorax. The antennæ are always very short, and, except in

Stygides, wide apart, terminated by an awl-shaped joint; the proboscis is ordinarily very short, scarcely advanced in front of the head, often received into the oral cavity, and terminated by a small thickened part formed of the lips. The palpi are generally hidden, filiform, and each is attached to one of the setæ of the rostrum. The abdomen is squarer than in Bombylius. These insects are generally very hairy. Their habits are very similar to those Diptera. They often alight on the ground, upon walls exposed to the sun, along which they are often observed flying, as well as upon leaves.

Stygides, Latr. (*Lomatia*, Enc. Méth., *Stygia*, Meig.), has the antennæ wide apart at the base.

In all the others they are wide apart at the base.

Some of these have the head subglobose, with the proboscis short, and the extremity of the wings not reticulated.

Anthrax proper, with the ocelli contiguous; [a very numerous genus, having the wings generally spotted].

Hirmoneura, Wied., with the anterior ocellus at a distance from the other two, and the proboscis retracted.

The others have the head shorter, subhemispherical, the proboscis longer than the head, and the extremity of the wings often strongly reticulated.

Mulio, Latr., has the wings reticulated in the usual manner, and the proboscis but little longer than the head.

Nemestrina, Latr. (*Cytherea*, Fabr.), has the extremity of the wings reticulated, as in the Neuroptera, and the proboscis much longer than the head; the two basal joints of the antennæ very nearly equal, and the last very short and conical; the tarsi have three pulvilli.

Fallenia, Meig., is formed of two species of Nemestrina, which scarcely differ from Anthrax in the reticulation of the wings.

Colax, Wied., also appears to us to approach the terminal Anthracii in the antennæ and wings, but the oral cavity is closed, as in Œstrus, and the ocelli are wanting.

Our second general division of the Tanystoma has the proboscis membranous, with the basal part generally very short, terminated by two lips, very distinct, and ascending. The larvæ of the terminal Diptera of this division have the head of a variable form.

Some of these (*Leptides*) have the wings extending, and exhibiting many complete cells; the antennæ do not terminate in a plate, and the palpi are filiform or conical.

Thereva, Latr. (*Bibio*, Fab.), has the palpi withdrawn into the oral cavity; the antennæ are fusiform or elongate-conic at the tips, with a small articulated terminal style. Type, *Bibio plebeia*, Fab., which is found on plants. The larva of *T. hirta*, De Geer, lives in the earth, and resembles a small Serpent; its body is white, and pointed at each end. It entirely strips off its skin on assuming the pupa state.

In the others the palpi are exterior, and the last joint of the antennæ is either globose or kidney-shaped, ovoid or conic, and terminated in all by a long seta. The tarsi have three pulvilli. Such is

LEPTIS,—

Which is divided into numerous subgenera.

Atherix, Meig., has the basal joint of the antennæ larger than the second; thick, at least in one sex, and with the third joint lenticular and transverse; the palpi are porrected.

Leptis, Fab., formerly *Rhagio*, Fab., has the terminal joint of the antennæ subglobose, or ovoid, always terminated in a point, and never transverse. In *Leptis*, Macquart, the antennæ are shorter than the head, with the three joints nearly equal in size, and the palpi porrected. Type, *Musca scolopacea*, Linn., a very common species.

Chrysopilus, Macq., differs from the last in having the palpi perpendicularly elevated.

[*Vermileo*, Macq.], has the antennæ as long as the head, with the first joint cylindric, the second short, the third conical, and the palpi recurved. Type, *Musca Vermileo*, Linn. [*Vermileo De Geeri*, Macq., a species common in France, but not discovered in England]. The larva is cylindrical, with the front of the head attenuated, and four fleshy lobes at the other end of the body. It gives to its body all kinds of curvatures, crawling on the sand, in which it forms a conical burrow, at the bottom of which it conceals itself, either entirely or only in part, suddenly starting when an insect falls into the hole, and twisting itself round it, thrusting the hooks of its head into its body and sucking its juices. It then throws the carcase away, as well as the sand, by curving its body into an arch, and then suddenly letting it go. The pupa is concealed beneath a layer of sand. I have kept some of these larvæ, sent me by M. de Romaud, for nearly three years unchanged.

Clinocera, Meig., from its wings, appears to belong to the next division.

The other Tanystoma of our second division have the wings incumbent on the body, and only exhibit two complete or closed cells. The antennæ terminate in a palette, nearly always furnished with a seta. The palpi, in the majority, are flattened, and rest on the proboscis.

These characters, a compressed body, triangular head, slightly advanced like a muzzle; the abdomen curved beneath, and long slender legs armed with spines, particularly distinguish the genus

DOLICHOPUS, Fab., Latr.,—

Which now forms a small tribe, distributed by Macquart in a very natural manner, which we have adopted, except in reversing it, whereby Orthochile is brought to the head.

The male organs in some are accompanied by plate-like appendages.

Orthochile, Latr., has the proboscis forming a small beak.

In the rest the proboscis is short, or scarcely prominent.

Dolichopus proper, has the third joint of the antennæ nearly triangular, but little elongated, with a seta of moderate length, without a thickened knot between the middle and extremity.

These insects are often of green or copper colours; the legs are long, and very delicate. They station themselves on walls, the trunks of trees, leaves, &c. Some run with celerity on the surface of water. The male organs of generation are always external, large, complicated, and folded beneath the abdomen. *D. ungulatus*, Fab., the larva of which lives in the earth: it is long, cylindric, with two points in form of two recurved hooks. The pupa has two curved horns in front of the thorax.

Sybistroma, Meig., has the last joint of the antennæ nearly in the form of the blade of a knife, with a very long seta, knotted beyond the middle.

The male organs in the others are furnished with filiform appendages. In some the hind part of the antennæ is either oval, triangular, or very long.

Rhaphium, Meig., has it very long, and nearly lanceolate.

Porphyrops, Meig., has it hatchet-shaped or triangular, with a villose seta, the first joint of which is indistinct.

Medeterus, Fisch., has the seta simple and dorsal, with the basal joint distinct and elongated, and the last joint of the antennæ oval.

Hydrophorus, Macq., differs from Medeterus in having the seta entirely terminal.

In the others, the third joint of the antennæ is nearly globose, and the seta always villose.

Chrysotus, has it terminal.

Psilopus, has it inserted rather above.

Diaphorus, has it inserted lower, and the head nearly spherical, and entirely occupied by the eyes, in the males, thus appearing to conduct us to the next family, *Platypezinæ*. The wings, ocelli, and other characters derived from the parts of the head, corroborate those which we have mentioned, but it is impossible for us to enter into such details.

The Platypezinæ of Meigen, from which Macquart has judiciously removed the genus *Cyrtoma*, and to which we have added that of *Scenopinus*, and his family *Megacephali*, is composed of Diptera very similar in the proboscis, antennæ, and wings to Dolichopus, but the body is depressed, with the head hemispherical, and almost entirely occupied by the eyes, at least in the males. The legs are short, without spines, and with the posterior tarsi often flat and broad.

These Diptera are very small. Some of them have a seta in the last joint of the antennæ. Those in which it is terminal, and the eyes contiguous above in the males, form two subgenera.

Callomyia, Meig., has the basal joint alone of the posterior tarsi dilated, but as long as all the rest united.

Platypeza, Meig., has the four basal joints of the posterior tarsi flattened.

Pipunculus, Latr., (*Cephalops*, Fall.), has the seta inserted on the back of the third joint, near its base; the tarsi are not dilated, the eyes not united above in either sex, and the head nearly globose.

Scenopinus, Latr., has no seta to the terminal joint of the antennæ, which is narrower and longer than in the preceding.

THE THIRD FAMILY OF THE DIPTERA,—

THE TABANIDES,—

Has, for its characters, a proboscis exserted, and generally terminated by two lips; with the palpi porrected, the last joint of the antennæ annulated, and a sucker of three pieces. It comprises the genus

TABANUS, Linn.,—

And is composed of large flies, well known for the torments they inflict upon horses and cows, of which they pierce the skin, in order to suck their blood. The body is generally but slightly hairy; the head is as wide as the thorax, nearly hemispherical, and covered, except in a narrow space, particularly in the males, by the eyes, which are generally golden-green, with purple stripes. The antennæ are nearly as long as the head, 3-jointed; the last joint being terminated in a point without seta or style at the tip, often notched at the base above, with transverse divisions, in number from three to seven. The proboscis in the greater number is nearly membranous, perpendicular, of the length of the head or rather shorter, nearly cylindrical, and terminated by two elongated lips; the two palpi mostly rest upon it, and are thick, villose, conical, compressed, and 2-jointed; the sucker, inclosed in the proboscis, is composed of six pieces like lancets, and which from their number and respective situation represent the parts of the mouth of the Coleoptera. [It is only the females which possess this number of lancets; the mouth of the males is much weaker, and has only four. This sex is harmless

it being only the females which bite.] The alulets generally cover the halteres; the abdomen is depressed and triangular; the tarsi have three pulvilli.

These insects appear towards the end of spring, and are very common in woods and pastures, flying with a buzzing noise. They even attack man, to suck his blood; and cattle in some parts are sometimes nearly covered with blood from the continued attacks of these insects. That of which Bruce has spoken in his Travels, under the name of Tsaltsalyia, and of which even the lion is afraid, is probably a species of this genus.

Pangonia, Latr. (*Tanyglossa*, Meig.), has the proboscis much longer than the head, slender, scaly, generally pointed at tip, and with very short palpi: the last joint of the antennæ is divided into eight rings. The species are only found in hot climates, and subsist on the honey of flowers.

The rest have the proboscis shorter, or scarcely longer than the head; membranous; terminated by two large lips, and with the palpi at least equal to half the length of the proboscis; the last joint of the antennæ is divided into five or four rings.

Tabanus proper, has the antennæ scarcely longer than the head; the last joint is rather crescent-shaped, and divided into five rings, the first largest, with a tooth above. *T. bovinus*, De Geer, the Large Gad-fly, the larva of which lives in the ground: it is long and cylindric, narrowed towards the head, which is armed with two hooks; the pupa is naked, nearly cylindric, with two tubercles in front; the segments of the abdomen ciliated; and six points at its posterior extremity.

Tabanus maroccanus, Fabr., according to Desfontaines, attacks camels, which are sometimes covered with them.

The others have the antennæ evidently longer than the head, and terminated by a joint of an elongate-conic form, or nearly cylindric; and generally only with four annuli. The ocelli are wanting in many.

Silvius, Meig., has three ocelli, and the first joint of the antennæ is longer than the following, and cylindric.

Chrysops, possesses three ocelli, but the two basal joints of the antennæ are nearly of equal length. *C. cæcutiens*, Fabr., a common species, which greatly torments horses.

Hæmatopota, Meig., wants ocelli, and the basal joint of the antennæ is thick, and nearly oval in the males.

Hexatoma, Meig. (*Heptatoma*, previously), has the antennæ larger than the preceding, and cylindric, with the last joint very long; ocelli wanting.

THE FOURTH FAMILY OF THE DIPTERA,—

THE NOTACANTHA,—

Has, like the last, the third and last joint of the antennæ transversely annulated, or composed of five distinct joints (*Chiromyza*); the sucker is formed of only four pieces; the proboscis, of which the stem is very short, is nearly withdrawn into the oral cavity: the membranous consistence of this organ, and its reflexed lips; its clubbed palpi, also reflexed; the arrangement of the wings, which are mostly crossed over each other; the oval or orbicular form of the abdomen; and the scutellum often armed with points, distinguish the Notacantha from the Tabanides. But few of their larvæ have been observed: those hitherto observed, and which have been described by Swammerdam, Réaumur, and Rosel, are aquatic (see below), and approach those of the Athericera by their soft head of a variable form, [?] and by their habit of changing to pupæ beneath their own skins; but they preserve their former size and form, which is not the case with the Athericera. The larvæ of other Notacantha (*Xylophagus*), live in the rotten and moist parts of trees.

We divide the Notacantha into three principal sections, [*Mydasii, Decatoma*, and *Stratiomydes*].

The first, MYDASII, have no teeth or spines on the scutellum; the body is oblong, with the abdomen long, triangular, and conical; the wings are extended; the antennæ, which constitute the chief character, are composed either of five distinct joints, two of which form in some a club, and in others the extremity of a cylindrical stem; or of three joints, the last of which is largest, nearly cylindrical, gradually pointed, and divided into three annuli; so that these organs are always divided into five. If we except *Mydas*, in which we have the rudiments of a style, neither the latter nor the seta exists in any of these Notacanthæ; probably the two terminal joints represent them.

Some have the antennæ much longer than the head, 5-jointed, terminated in an elongate mass formed of the last two joints, with a very short terminal seta; the hind thighs are strong, and toothed or spiny beneath. The tarsi have only two pulvilli. The posterior cells are closed before reaching the apex of the wing. These Diptera compose the genus

MYDAS,—

Which is divisible into two subgenera.

Cephalocera, Latr., has the proboscis long, and advanced.

Mydas proper, has it short, and terminated by two large lips.

Others have the antennæ scarcely longer than the head, and cylindric; the tarsi have three pulvilli, and the posterior cells extend to the hind margins of the wings.

Chiromyza, Wied., has the antennæ with five distinct joints.

Pachystomus, Latr., has the antennæ 3-jointed, the third joint divided into three annuli. The larva of *P. syrphoides*, Pz., lives beneath the bark of the pine; its pupa resembles that of the Tabani.

The second section, DECATOMA, Latr., has the antennæ always composed of three joints, the last being longer, without a style or seta, and divided into eight annuli, clavate in some, and nearly cylindric, or elongate-conic in others. The wings are generally incumbent on the body, and the tarsi have three pulvilli. They may be united into a single genus—

XYLOPHAGUS.

Hermetia, Latr., has the antennæ much longer than the head, with the two first joints very short, and the third very long and compressed; the scutellum is narrowed.

The antennæ in the others are never much longer than the head, and terminated by a nearly cylindric, or elongate-conic joint. Some have the scutellum not spined.

Xylophagus proper, has the body long and narrow, with the antennæ rather longer than the head, terminated by a subcylindric joint. *X. ater*, Latr.

Acanthomera, Wied., has the antennæ at least as long as the head, and terminated by a joint in the form of an elongate cone; the first joint larger than the others; the abdomen broad and flattened; the face with a pointed beak; the two joints of the palpi of equal size.

Raphiorhynchus, Wied., has the basal joint of the palpi very short, and the second much longer, and terminated in a point. The species of this and the preceding are of large size, and inhabit South America.

The others have the scutellum armed with spines.

Cænomyia, Latr. (*Sicus*, Fabr.), are closely allied to the two preceding subgenera; the antennæ scarcely longer than the head; the palpi very visible, cylindric, pointed at the tip, with two equal-sized joints. The scutellum has two spines. *S. ferrugineus*, Fab.

Beris, Latr., has the antennæ rather longer than the head, with the two basal joints of equal size, and the third elongate-conic. The scutellum has four or six spines.

Cyphomyia, Wied., has the antennæ still more elongate, and the basal joint longer than the second; the third linear and compressed. The scutellum has two spines.

[*Ptilocera*, Wied.], (not *Ptilodactylus*, as written by Latreille), has the antennæ emitting three or four linear, villose filaments, the tips being nearly setaceous. The scutellum has four teeth.

Platyna, Wied., has the antennæ filiform; the two basal joints elongate-cylindric; the scutellum with one spine, [and the abdomen very greatly dilated].

The third section, STRATIOMYDES, Latr., has also the antennæ 3-jointed, the last joint offering not more than five or six annuli, the style, or seta, not included. The latter exists in nearly all; and in those which do not possess it the third joint is long, elongate-fusiform, and always divided into five or six joints; the wings are always incumbent upon each other. In some of the species, which have the antennæ terminated by an oval or globular mass, and always aristate, the scutellum is not spined. This section corresponds with the genus

STRATIOMYS, Geoff.

Some have the third joint of the antennæ elongate, fusiform, or conical, without a terminal seta, and mostly terminated by a 2-jointed style. The scutellum armed with two teeth, or spines, in the majority.

In the four following subgenera the proboscis is short, and the front of the head does not form a beak.

Stratiomys proper, has the antennæ much longer than the head, the first and last joint greatly elongated; the last with at least five distinct joints, without a sudden style at the tip. The larvæ have the body long, flat, coriaceous, and annulose; the three terminal joints, long and slender, form a tail, terminated by a coronet of hairs; the head is scaly, small, oblong, and furnished with a number of small hooks, serving to disturb the water, in which these larvæ reside. They respire by extending their tails to the surface, a spiracle being situated between the scales, at the extremity of the body. The skin, unchanged in form, serves as a cocoon to the inclosed pupa, which, however, only occupies one extremity of the larva skin. The perfect insect escapes by a slit made through the second segment.

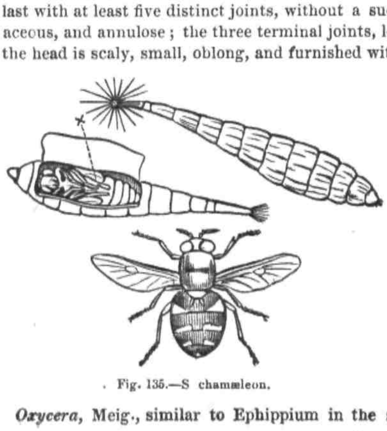

Fig. 135.—S chamæleon.

S. chamæleon, Fab., a very common species.

Odontomyia, Meig., have the antennæ scarcely longer than the head, with the first two joints short nearly equal, the third forming an elongate cone, slender, with at least five distinct joints; the last conic, suddenly compressed, and recurved.

Ephippium, Latr. (*Clitellaria*, Meig.), has the antennæ scarcely longer than the head, with the two basal joints short, the third forming a shorter cone, thicker, the fourth joint truncate-conic, suddenly narrowed at tip, and terminated by a 2-jointed style. *S. ephippium*, Fab. (*E. thoracicum*, Latr.).

Oxycera, Meig., similar to Ephippium in the shortness of the antennæ, which are also styliferous, but with

the third joint shorter, nearly ovoid, and the fourth joint shorter, the style not terminal, but dorsal. *O. Hypoleon*, Fab.

Nemotelus, Geoff., differs from the preceding in having the proboscis long, siphon-shaped, elbowed at the base, and lodged in a frontal protuberance of the head, like a beak.

In the others the third joint of the antennæ forms, with the preceding, an ovoid or globular mass, terminated by a long seta. The scutellum is rarely spined.

Chrysochlora, Latr. (*Sargus*, Fab.), has the third joint of the antennæ conic, and terminated by a seta.

Sargus, Fab., has the same joint subovoid, or nearly globose, rounded, or obtuse at the tip, with the seta dorsal. The first joint is nearly cylindrical; the scutellum rarely spined; the body often elongate, green, or coppery, and brilliant. *Musca cupraria*, Linn., a very common species, the larva of which resides in cow dung, and is of an oval, oblong form, narrowed and pointed in front, with a scaly head furnished with two hooks. It becomes a pupa beneath its own skin, and without materially altering its form.

Vappo, Latr. (*Pachygaster*, Meig.), differs chiefly from Sargus in the antennæ being shorter, with the basal joints transverse.

Our second general division of those Diptera which have a sucker received in the proboscis, or sheath, and the antennæ only 2- or 3-jointed, comprises those which have the proboscis generally membranous, bilabiate, long, elbowed, and bearing two palpi implanted a little above the elbow, and most commonly received into the oral cavity, and has only two pieces in the sucker, when it is always protruded. The last joint of the antennæ, always furnished with a style or seta, has no annular division. The palpi are hidden in repose. This division forms

THE FIFTH FAMILY OF THE DIPTERA,—

THE ATHERICERA,—

The proboscis of which is generally terminated by two large lips; the sucker has never more than four, and often only two pieces. The larvæ have the body very soft, contractile, annulated, narrower in front, with the head of a variable figure, and its external organs consisting of one or two hooks, accompanied in some genera with fleshy lobes, and probably in all with a sort of tongue destined to receive the nutritive fluids. The spiracles are four in number; two placed in the prothorax, and two at the extremity of the body, on scaly plates; each of the latter is formed, in many, of three small spiracles close together. These larvæ do not change their skins; that which they first possess hardens, and becomes a kind of cocoon for the pupa. It also shortens, and assumes an oval form; the anterior part, which was slenderest in the larva, thickens. We also discover in it traces of articulation, and often vestiges of spiracles, although they no longer serve for respiration. [The manner in which the transformation to the pupa state is effected, is described in the general observations on the order, and need not be repeated.]

Few of the Athericera are carnivorous in the perfect state. They are found, for the most part, on flowers, leaves, and sometimes on human excrement.

This family comprises the genera *Conops*, *Œstrus*, and the major part of that of *Musca*, of Linnæus.

We naturally commence with those species of the latter genus, which have the sucker formed of four pieces and not of two, as in all the other Athericera. They form a first tribe, SYRPHIDÆ.

The proboscis is always long, membranous, elbowed near the base, terminated by two large lips, and the sucker inclosed in an upper canal; the upper piece of the sucker is thick, and notched at the tip, the others are slender; to each of the two labial ones, representing maxillæ, is attached a small, slender palpus; the head is hemispherical, and occupied for the most part by the eyes, especially in the males. Its anterior extremity is mostly produced like a muzzle, or beak, receiving the proboscis when it is folded in inaction. Many species resemble Humble-bees, and others Wasps. This tribe comprises but a single genus,

SYRPHUS,—

A first general division of which is composed of those with the proboscis shorter than the head and thorax.

Some of these have the front of the head produced into an eminence above the oral cavity; at the head of these are placed such as have the seta of the antennæ plumose; the body short and hairy, resembling Humble-bees.

Volucella, Geoffr., has the third joint of the antennæ oblong, its outline forming a curvilinear and elongate triangle.

Musca mystacea, Linn., a very common species, the larva of which lives in the nests of Bombi, its body being

gradually widened behind, with small points on the sides, and terminated by six filaments. It is furnished beneath with two spiracles and six fleshy lobes, each armed with three long hooks.

Sericomyia, Meig., has the third joint of the antennæ semiorbicular.

Eristalis, Meig., restricted to the species which have the seta villose, and which differ from Volucella in the wings, which have the outer cell closed by the posterior edge of the wing.

Others differ from the preceding by having the seta of the antennæ simple, or without distinct hairs; the body short, and the abdomen triangular.

The two following subgenera have the last outer cell of the wings strongly sinuated on the outer edge, and the body is generally hairy.

Mallota, Meig., has the last joint of the antennæ transversely trapeziform.

Helophilus, Meig., has the same joint of a semi-oval form; the body less hairy than in the preceding. The larvæ of many have the body terminated by a long tail, which they can elongate and elevate perpendicularly until it reaches the surface of the water or cloaca in which they reside, in order to respire by means of the aperture at its extremity. Their interior presents two large and very brilliant tracheæ, which, near the tail, are much folded, and kept in constant agitation; vessels filled with rain-water often contain many of these larvæ. Type, *Musca tenax*, Linn., a very common species, resembling in size and colour the male of the Hive Bee. Its larva is rat-tailed; and it is said to be so tough, that the strongest pressure will not destroy it.

Others differ in having the outer cell of the wings closed by the posterior margin of the wing, its outer edge being straight, or but feebly sinuated; the frontal prominence is very short, and the abdomen narrower than in the preceding.

Syrphus proper, (*Scæva*, Fabr.), has the abdomen narrowed from the base to the apex. Their larvæ feed only upon all kinds of Aphides, which they often hold up in the air, and suck them very quickly; the body of these larvæ is of an elongate-conic form, uneven, and even sometimes spinose. When ready to metamorphose, they fix themselves to leaves or other substances by a glutinous secretion; the body shortens, and its anterior end, which was the slenderest, becomes the thickest. *Scæva Ribesii*, Fabr., [a very common species].

Chrysogaster, Meig., has the forehead of the females channelled on each side; and the nasal eminence is thicker.

Baccha, Meig., differs from the last in having the abdomen narrow at the base, and swollen at the tip. I think the *Syrphus conopseus* [genus *Doros*], ought to be added to this, although the palette of its antennæ is less orbicular.

We now pass to other subgenera, agreeing with the preceding in the form of the muzzle, but the antennæ are at least as long as the face.

Paragus, Linn., has the antennæ not fixed on a common footstalk, and their length does not exceed that of the head.

In the five following, they arise from a common elevated footstalk, and are larger than the head.

Sphecomyia, Latr., has the seta lateral, and inserted on the second joint; the third joint being very short. A species from Carolina.

Psarus, has the seta inserted on the back of the third joint, near the top; this joint is nearly oval, of the same length as the second joint; the peduncle of the antennæ is more elevated than in the analogous genera.

Chrysotoxum, Meig., has the seta inserted on the third joint, near the base; this joint is the longest, forming a narrow and elongate triangle; the two others are nearly equally long.

Ceria, Fabr., has the seta terminal; the body narrow and elongate, like that of a Wasp; the second and third joints of the antennæ form a fusiform mass; the abdomen is long and cylindric.

Callicera, Meig., has the seta terminal, and the body short, broad, and silky. The nasal prominence does not exist in the following subgenera; the antennal seta is nearly always simple, and the wings incumbent on each other.

Ceratophya, Wied. (with an unarmed scutellum), and

Aphrites, Latr. (*Microdon*, Meig., with the scutellum armed with two teeth), agree with the last subgenera in the length of the antennæ, close together at the base. In the following, they are shorter than the head; and the hind legs are often large, especially in one sex.

Merodon, Meig. (having the abdomen triangular and conical), and

Ascia, Meig. (with the abdomen narrowed at the base, and clavate), have the palette of the antennæ oblong-triangular. In the following it is short, or but slightly elongated, sub-orbicular, or sub-ovoid.

Sphegina, has the abdomen clavate, as in Ascia. In the others, it is triangular, conic, or subcylindrical.

Some of these have the wings not extending beyond the extremity of the abdomen; and some have the hind thighs thickened, and armed with numerous small spines.

Eumerus, Meig., to which we add his *Xylota*, which differs only in having the abdomen narrower, and almost linear. *M. pipiens*, Linn.

Milesia, Latr. (*Tropidia*, Meig.), has the two hind legs much longer than the others, with the thighs much thicker, and armed with a single tooth; in many, the abdomen is conical.

Pipiza, Meig. (and *Psilota*, Meig.), have the hind legs little longer than the others; the abdomen depressed and semi-elliptic. These Diptera have much affinity with the *Syrphi* and *Chrysogasteri*.

Brachyopa, Hoffm., differs from all the preceding in the wings extending far beyond the abdomen, [in consequence of the shortness of that part of the body]. They otherwise resemble *Milesia*, and appear to lead to *Rhingia*.

Rhingia, Scop., forms the second general division of the *Syrphies*, having the proboscis longer than the head and thorax and nearly linear.

Pelecocera, Hoff., is unknown to me, but is at once distinguished from all with the antennæ shorter than the head, by the short, thick seta of the antennæ.

The sucker of all the other Athericiræ is only composed of two setæ, of which the upper represents the labrum, and the lower the tongue.

These Athericeræ form three small tribes, which correspond with the genera *Œstrus* and *Conops* of Linnæus, and with that of *Musca* of Fabricius, as at first proposed by him.

As *Stomoxys* and *Bucentes* are connected with the last of these genera, we shall commence with the tribe ŒSTRIDES, Latreille, which is composed of the genus

ŒSTRUS, Linn.,—

Well characterised by possessing, in the place of a mouth, only three tubercles, or but slight rudiments of a proboscis and palpi.

These insects have the appearance of large meat-flies, very hairy, their hairs being generally coloured in rings, like Humble-bees. Their antennæ are very short, each inserted in an excavation below the forehead, and terminated by a rounded palette, bearing on its back, near the base, a simple seta; the wings are generally apart; the alulets large, and hiding the balancers; the tarsi are terminated by two ungues, and two pulvilli.

These insects are found but rarely in the perfect state, the time of their appearance being very limited. As they deposit their eggs on the bodies of various herbivorous quadrupeds, it is in woods and pastures frequented by these animals that they are to be sought after. Each species of Œstrus is ordinarily parasitic upon a single mammiferous animal, selecting, as the situation for its eggs, that part of the body which is best fitted for the larvæ, which either remain in that particular situation, or are passed from thence to a more favourable place of developement. The Ox, Horse, Ass, Rein-deer, Stag, Antelope, Camel, Sheep, and Hare, are the only quadrupeds hitherto known to be subject to the presence of the larvæ of Œstri. These animals appear to have a strange dread of the insect, when it seeks to lay its eggs upon them.

The nature of the abode of these larvæ is of three kinds, which may be distinguished as cutaneous, cervical, or gastric, according as they reside either in tumours formed in the skin, or in some parts of the head or stomach of the animal destined to support them. The eggs, whence the larvæ of the first kind are hatched, are placed by the parent fly beneath the skin [of oxen, &c.], which it [is stated by some authors, including Latreille, but evidently erroneously,] to pierce with its ovipositor, composed of four tubes, entering into one another, and armed at the tip with two hooks, and two other pieces; this instrument is formed of the terminal segments of the abdomen. These larvæ, called *taons* by the French peasantry [and *worbles* or *wornils* by the English], have no need to change their situation, finding themselves, as soon as born [or rather as soon as they have buried beneath the skin], in the midst of a purulent humour, which serves them for nourishment. The eggs of the other species are merely stuck upon various parts of the body, either close to natural and internal cavities, into which the larvæ easily penetrate, and there fix themselves, or where the animal is in the habit of licking itself, whereby the larvæ are carried by the tongue into the mouth, and so pass to the place [in the stomach] destined to receive them. It is thus that the Sheep Bot-fly places its eggs at the inner edge of the nostrils of that quadruped, which becomes agitated, stamps the ground with its fore feet, and hurries away with its head to the ground; the larva insinuates itself into the maxillary and frontal sinuses, and fixes itself to the internal membrane with which they are lined, by means of two strong hooks with which its mouth is armed. It is thus, also, that the Horse Bot-fly deposits its eggs, without settling, by hovering in the air at intervals over the inner part of the legs, at the sides of the shoulders, and sometimes on the withers. *Œstrus hæmorrhoidalis*, the larva of which also lives in the stomach of the Horse, places its eggs upon the lips; the larvæ, attaching themselves to the tongue, pass by the œsophagus into the stomach, where they subsist on the humour secreted by its inner membrane. They are generally found round the pylorus, and rarely in the intestines. They often exist in great numbers, hanging like a bunch of grapes: Mr. Clark, nevertheless, considers that they are rather serviceable than otherwise to the Horse.

These larvæ have, in general, a conical form, and are destitute of legs. Their body is composed of eleven segments, exclusive of the head, furnished with small tubercles and spines, often arranged in bands, and which facilitate their progression. The principal organs of respiration are situated in a

scaly plate at the posterior extremity of the body, which is thickest. It appears that their number and arrangement are different in the gastric larvæ: it also appears that the mouth of the cutaneous larvæ is only composed of fleshy lobes, whilst that of the internal larvæ is armed with two strong, bent hooks.

When the larvæ have obtained their full size, they quit their former abode, fall to the earth, and there hide themselves, in order to undergo those transformations to pupæ beneath their own skin, like the other Diptera of this division. The gastric larvæ pass through the intestines and escape by the anus, probably with the excrement. It is generally in June and July that these changes take place.

M. Humboldt has observed, in South America, Indians with the abdomen covered with small tumours, produced, as he believed, by the larvæ of Œstri; and later observations appear to confirm this opinion. These larvæ probably belonged to the genus *Cuterebra* of Clark, the larvæ of which reside beneath the skin of several mammiferous animals. It also appears, from various testimony, that larvæ analogous to those Œstri have been extracted from the maxillary or frontal sinuses of Man; but these observations have not been pursued.

Some have a small and retractile proboscis.

Cuterebra, Clark, has the seta of the antennæ plumose, and the palpi not visible. *Œstrus buccatus*, Fab.; *Cuniculi*, Clark; and *Ephippium*, Latr.; all from America.

Cephenemyia, Latr., has the seta simple, and the palpi evident. *Œstrus Trompe*, Fab., the larva of which infests the frontal sinus of the Rein-deer.

The others have no proboscis, and the seta of the antennæ is always simple.

Œdemagena, Latr., has two palpi. *Œstrus Tarandi*, the Bot of the Rein-deer.

The following have no palpi.

Hypoderma, Latr., with a small oral aperture like a Y. *Œstrus Bovis*, the larva of which resides in tumours on the back of Oxen.

Cephalemyia, Latr., has two small tubercles like points, which are the vestiges of palpi; the alulets cover the balancers. *Œstrus Ovis*, the Sheep Bot-fly, the larva of which lives in the frontal sinuses of the Sheep.

Œstrus proper (*Gastrus*, Meig., *Gasterophilus*, Leach), has two similar tubercles, but the wings cross each other, and the alulets only partially cover the halteres.

Œstrus Equi, the Great Horse Bot, *hæmorrhoidalis*, *veterinus*, &c. This differs in the cells, extending to the hind edge of the wings, whereas in all the rest (which Leach and Meigen retain under the name of *Œstrus*) the cells are closed before reaching the hind margin.

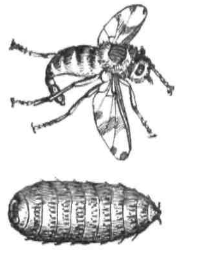

Fig. 136.—Gasterophilus equi

The third tribe of the Athericera, that of the CONOPSARIÆ, is the only one in which the proboscis is always exserted and siphon-shaped, either cylindric, conical, or setaceous. The reticulation of the wings is the same as in our first division of Muscides. The majority of these insects are found on plants. They compose the genus

CONOPS, Linnæus.

Some have the body long and narrow; the abdomen long, clavate, and bent under at the tip, with the male organs exposed.

One portion of these has the proboscis only elbowed at the base.

Systropus, Wied. (*Cephenes*, Latr.), has the antennæ much longer than the head, the last joint alone forming the club, without a style, and the abdomen long and slender. South American insects, like small species of *Sphex*.

Conops proper, has the antennæ much longer than the head, and the last two joints form together a mass, with a terminal style.

Conops rufipes, Fab., which undergoes its transformations in the interior of the body of living Bombi, escaping between the segments. An apod larva, found in *Bombus lapidarius*, being probably that of this species, has furnished Messrs. Audouin and Lachat materials for some fine anatomical observations.

Zodion, Latr., has the antennæ shorter than the head, terminating in an ovoid mass.

Myopa, Fab., has the proboscis elbowed at the base, and again near the middle, the apex being bent under, and the antennæ shorter than the head. [Several British species.]

The others (*Stomoxydæ*, Meig.), resemble domestic Flies in their general form, the arrangement of their wings, the antennæ terminated by a palette shorter than the head, and furnished with a seta, and the abdomen short and conical, without external appendages.

Stomoxys proper, has the proboscis only elbowed at the base. Type, *Conops calcitrans*, Linn. [a very common insect, often observed on windows, and which is the species] which pricks our legs so sharply, especially before rain.

Bucentes, Latr. (*Stomoxys*, Fab., *Siphona*, Meig.), has the proboscis elbowed twice, as in Myopa.

Carnus, which Nitzsch refers to this family, is distinguished by having only the rudiments of wings; the direction of the proboscis, and the form of its antennæ and body, seem to indicate that it comes near Stomoxys.

The fourth and last tribe, MUSCIDES, is distinguished from the preceding by having a proboscis always very apparent, membranous, and bilabiate, generally bearing two palpi (except in *Phora*), and capable of being entirely withdrawn into the oral cavity, and a sucker of two pieces. The antennæ always terminated by a palette with a lateral seta.

These Athericera embrace the ancient genus *Musca* of Fabricius, which the works of Fallen and Meigen (without speaking of our own) have singularly modified. The difficulties, however, which oppose its investigation, are nevertheless far from removed; for although these authors have established a great number of genera, there are, nevertheless, some, such as *Tachina* and *Anthomyia*, which can only be regarded as magazines. In the work of Meigen, which is confined to the European Diptera, the first of these genera comprises 315 species, and the second 213. Dr. Robineau Desvoidy, anxious to complete these researches and serve science, has undertaken with much zeal the special study of the *Muscides*, which he terms *Myodaires*, and has presented a memoir upon the subject to the Royal Academy of Sciences, [since published]. As Latreille, however, was only acquainted with the general distribution of this tribe through the report of M. de Blainville, presented to the Academy, he was not able to make use of it: indeed, it would too far exceed the limits of this work to do so, and probably alarm young naturalists by the multitude of genera which he has established, and which appeared to the reporter to be too slightly characterized. We think that the work of Meigen, except in respect to the revision of the two genera above mentioned, is quite sufficient, in the actual state of the science. [The vast extent of this tribe, which probably equals that of all the other Diptera united together, has, notwithstanding the remarks of Latreille, rendered the establishment of many additional genera requisite. M. Macquart, in his *Histoire Naturelle des Diptères*, and Messrs. Haliday and Walker, in various detached memoirs, have added to the number of those proposed by Meigen, although they have materially reduced the number proposed by Robineau Desvoidy, which amounted to 354, divided into ten primary groups, two of which still remain unpublished, and which will of course increase the number of his genera.]

This tribe comprises the genus

MUSCA.

The first section comprises those species which have the antennæ inserted near the forehead; the palpi placed upon the proboscis, and retractile with it into the oral cavity, and transverse nerves to the wings. This section comprises eight principal groups, or subtribes.

The first division (CREOPHILÆ) has very large alulets, nearly covering the balancers. The wings are generally apart, with the two terminal and external cells of the posterior limb closed by a transverse nervure.

Some of these have the epistome not beak-like, and the sides of the head not advanced into horns.

A portion of these have the seta of the antennæ naked.

Echinomyia, Dumeril, has the second joint of the antennæ longest; the last is nearly trapezoidal, with the seta biarticulate at its base. *Musca grossa*, Linn., the largest known species, nearly as large as a Humble-bee. It is black, very bristly, with the head buff, eyes brown, and base of the wings reddish. It makes a loud buzzing, settles upon flowers in woods, and often upon cow-dung, on which its larva resides; the body of which is yellowish, shining, conical, with a single hook, and two fleshy horns at its anterior extremity; the other being terminated by a circular plate, upon which are two spiracles, each placed upon a lenticular lobe, elevated in the middle. The segment after the head is also furnished on each side with a spiracle. In the cocoon of the pupa, which is also conical, the posterior extremity also presents two more distinct spiracles; its contour formed by a plate with nine flaps. [It appears to me that Latreille has erred in referring Réaumur's figures to *Echinomyia grossa*. They seem to me to be those of the transformations of *Mesembrina meridiana*. I presume that the larva of *Echinomyia grossa* is a parasite.]

In the other Creophilæ the third joint of the antennæ is never shorter than the second. Sometimes the face is nearly naked, and never clothed with long bristles.

Gonia, Meig., has the seta of the antennæ elbowed, and the abdomen with distinct segments, and convex.

Miltogramma, Meig., has the abdomen also convex, with distinct joints, and the seta of the antennæ straight.

Trixa, Meig., differs from Miltogramma in having the third joint of the antennæ scarcely longer than the second.

In the four following subgenera the abdomen is swollen, with the articulations indistinct, or flattened.

Gymnosoma, Meig., has the abdomen vesicular, with indistinct articulations, and the antennæ as long as the head.

Cistogaster, Latr., has the abdomen similar, but the antennæ much shorter.

Phasia, Meig., has the abdomen very flat and semicircular, and the tibiæ but slightly bristly.

Trichiopoda, Latr., has the abdomen flat but oblong, and the hind tibiæ with a row of lamelliform bristles.

Sometimes the face has two rows of long bristles, like moustaches, two being larger than the rest.

The three following have the wings vibratile, and the abdomen narrow and elongate; the antennæ are not shorter than the face.

Lophosia, Meig., has the last joint of the antennæ forming a large triangular palette.

Ocyptera, Meig., has the third joint of the antennæ seldom much larger than the preceding, and forming a linear or oblong square. M. Dufour has observed the transformations of two species; the larva of *O. cassidæ*, residing in the visceral cavity of *Cassida bicolor*, and that of *O. bicolor*, in the same cavity of *Pentatoma grisea*: both these larvæ feed on the fatty matter of the insects they infest; their bodies are oblong, soft, whitish, perfectly glabrous and contractile, and terminated by a sort of siphon one third of the length of the body, of a more solid consistence, and unchangeable in its form, with two hooks at the tip: the posterior extremity of this siphon, occupying one of the metathoracic spiracles [of the insect infested], and in contact with the air, enables the parasite to respire. Neither antennæ nor eyes have been observed. It is in the same situation that the larva changes to the pupa state. This [or rather the old larva skin] is ovoid, without any trace of segments, with several tubercles at one end. It quits its abode before assuming the perfect state, either without destroying the insect, or the larva infested, or after it has killed it.

Melanophora, Meig., has the antennæ much shorter; the antennæ not extending lower than the middle of the face; the outer terminal cell is more advanced posteriorly than the inner one.

The abdomen of the other Creophilæ is but little elongated, triangular; and the wings are not vibratile.

Phania, Meig., has the abdomen 4-jointed; the tip being elongated, narrowed, and folded beneath; the third joint of the antennæ is long and linear.

Xysta, Meig., has the abdomen 5- or 6-jointed, and the antennæ short, with the last two joints nearly equal; the hind tibiæ are rather curved, compressed, and ciliated.

Tachina, Fabr., has the abdomen 4-jointed, but not recurved at the tip; the antennæ as long, or nearly as long, as the head; the last joint longer than the preceding. Some of the species, forming a peculiar group, live whilst larvæ in the bodies of different caterpillars, which they destroy.

We now pass to Creophilæ which have the seta of the antennæ evidently villose or plumose; the third joint always forms an elongated palette, and is longer than the preceding joint.

Dexia, Meig., has the habit of Ocyptera, with the abdomen narrow and elongated, especially in the males.

Musca proper (*Mesembrina*, Meig.), has the abdomen triangular, the eyes contiguous, or very close together in the males. Here are to be arranged the majority of the flies of which the larvæ feed upon meat, carcases, &c., and others in manure. They have all the form of soft worms; whitish in colour; destitute of feet; thickened and truncate at the posterior extremity, and pointed at the other end, where are one or two hooks, with which these larvæ gnaw their food, and of which they hasten the corruption. They undergo their changes in a very few days [in the summer]; the females have the extremity of the body narrowed, and elongated into a tube, to enable them to bury their eggs. *Musca vomitoria*, Linn., the Common Meat Fly, with the forehead fulvous; the thorax black, and abdomen blue, with black marks. It possesses a remarkably fine sense of smelling, and makes a loud buzzing noise, when it enters our houses in order to deposit its eggs on meat. Deceived by the odour of *Arum dracunculus* when in flower, it sometimes deposits its eggs in that flower; when ready to assume the pupa state, it quits its food and descends into the earth, or else undergoes its change in some dry and retired situation. *M. domestica*, Linn., the small Common Domestic Fly, the larva of which lives in moist manure.

Sarcophaga, Meig., differs from Musca, by the eyes being wide apart in both sexes; the eggs in some species are hatched within the abdomen of the parent, as is the case with *M. carnaria*, Linn. [a very abundant species], which is larger and longer than the Meat Fly: the female deposits her young larvæ upon flesh, carcases, and sometimes in the wounds of persons.

We terminate the Creophilæ by some subgenera contrasting with the preceding in the form of the head, situation of the wings, or of their external cells.

Achias, Fabr., remarkable for the horn-like elongations of the sides of the head; with the antennæ inserted high in the forehead.

Idia, Meig., has the front of the head produced into a beak.

The two following have the terminal cells of the wings extending to the posterior edge; the abdomen is flattened.

Lispe, Latr., has the body oblong; the antennæ nearly as long as the face; and the style plumose.

Argyritis, Latr., has the body short; the abdomen very flat, nearly semicircular; the head short and broad; the antennæ very short; with the seta elbowed.

In all the remaining *Muscides*, the alulets are small, or nearly obsolete; the balancers exposed; and the principal nerves of the wings extending to the outer edge of the wings, which closes the posterior cells.

A second general division of the Muscides, that of the ANTHOMYZIDES, is composed of species having

the appearance of Common Flies; the wings not vibratile; the antennæ inserted near the forehead, always shorter than the head, terminated by a long or linear joint, with the seta mostly plumose; the legs are of moderate size, and the abdomen composed of four joints.

Anthomyia, Meig., has the seta of the antennæ plumose; the abdomen in both sexes pointed at the tip, and the proboscis not terminated like a hook. *Musca pluvialis*, Linn.

Drymeia, Meig., has the proboscis exhibiting this character, and the eyes united behind, in the males.

Cænosia, Meig., has the abdomen of the males swollen at the tip. The larvæ of *C. fungorum* live in boleti, and often in the edible mushroom. De Geer observed, also, that these larvæ will destroy each other.

Eriphia, Meig., has the antennæ shorter, with a simple style, and the eyes of the males united behind.

Our third division, HYDROMYZIDES, has the head almost triangular, with the eyes very prominent; a swollen and vaulted muzzle; a very thick proboscis; and the sides of the face not bristly; the antennæ are very short, with the style plumose: the legs are strong. All the indigenous species are found in aquatic situations.

Ropalomera, Wied., has all the thighs swollen, and the face has a frontal tubercle.

Ochthera, Latr., has the thighs of the fore-legs very robust, denticulated beneath; the tibiæ curved, and applied against the thighs, and terminated by a strong spine. In the following Hydromyzides, the thighs are not swollen.

Ephydra, Fall., has the eyes very prominent; the muzzle thick; and the seta of the antennæ thick at the base, and simple.

Notiphila, Fall., has the head rounder, without a frontal muzzle.

The Muscides of the three following divisions have the body oblong; the wings incumbent, not vibratile; the head nearly spherical, and the face covered by a white membrane, with an impressed line on each side. The antennæ are sometimes inserted in fossulæ, but oftener porrected, and in many as long or longer than the head.

The fourth division, SCATOMYZIDES, are distinguished by the head being never longer than broad, nearly spherical; the hind legs not greatly elongate; the antennæ, with the third joint longer than the preceding, and, except in *Loxocera*, always shorter than the head.

Some have the hind legs large, with thick compressed thighs; and the antennæ very short; with a simple seta.

Thyreophora, Latr., has the antennæ lodged beneath a frontal prominence; and the second and following joints of the tarsi nearly alike. *T. cynophila*, Panz., has the scutellum bispinose; it is almost always found on the dead carcases of dogs, and M. Percheron has assured me it is sometimes phosphorescent.

Sphærocera, Latr. (*Borborus*, Meig.), has the antennæ exposed, with the palette hemispherical; the hind thighs are compressed, with the two basal joints of the tarsi evidently larger than the following. It is almost always about manure that these Diptera are found, and it is probably there that their larvæ reside.

Sometimes the hind legs do not materially differ from the others; the antennæ are nearly as long as the face, deflexed, and terminated by an elongated, narrow palette.

Dialyta, Meig., has the face bristly; the abdomen 4-jointed, and the seta of the antennæ simple.

Cordylura, Fall., has the face bristly; the abdomen 5-jointed, and the wings scarcely extending beyond the abdomen.

Scatophaga, Latr., differs from the last in having the wings longer than the abdomen, which is never clavate. *Musca stercoraria*, Linn., a very common buff-coloured species, found in great numbers upon excrement, in which the females deposit their eggs.

Loxocera, Latr., has the face not bristly; the body long, narrow, and the antennæ much longer than the head.

Chyliza, Fall., has the antennæ shorter than the head, with the seta thick, like a style.

The others have the antennæ always much shorter than the face, with the palette either oblong, ovoid, or nearly globose.

Some of these have the body narrow and elongate, and the abdomen pointed or stylate; sometimes the face is naked.

Lissa, Meig., has the upper side of the head with an elevation, and the abdomen is almost linear.

Psilomyia, Latr. (to which *Geomyza*, Fall., may be added), has the body less elongate, and the abdomen terminated by an articulated style.

Tetanura and *Tanypeza*, Meig., are allied to the preceding; the legs in both seem longer, and the abdomen of Tetanura is obtuse at the tip, and that of Tanypeza pointed or stylate in the females.

Lonchoptera, Meig., has the face bristly at the sides, and the basal joint of the antennæ is very slender; the wings have no transverse nerve, except close to the base.

The body in the other Scatomyzides is thicker and more oblong, and its form is more like that of the common House-fly.

Heleomyza, Fall., has the head bristly.

Dryomyza, Fall. (with the face concave beneath the antennæ), and

Sapromyza, Fall. (with it straight), differ from the following in having the antennal seta plumose.

The terminal Scatomyzides have the seta simple; the antennæ always short and straight; they are small and glabrous Flies, black, and more or less varied with buff; the legs strong, and the eyes large. The upper side of the head is flat, with a brown, triangular mask, in which the ocelli are placed. They are found in flowers. Many of their larvæ mine the interior of vegetables, and some are very injurious to agriculturists, destroying various cereal plants previous to their fructification. The larvæ of *Musca Frit* sometimes destroy the barley crops in Sweden, to the amount of 100,000 golden ducats in a year, being one-tenth of the produce. The larvæ of *Oscinis pumilionis* and *lineata*, Fab., are equally obnoxious. They constitute our genus

Oscinis, Latr., to which we add the genus *Chlorops*, Meig., and *Piophila*, Fallen.

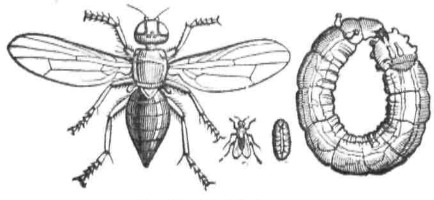

Fig. 137.—Piophila Casei.

The fifth division (DOLICHOCERA), which embraces the genus *Tetanocera*, Dum., is closely allied to the preceding, but the length of the second joint of the antennæ, which equals or surpasses that of the third, at once distinguishes it. These organs are porrected, as long as, or longer than, the head, and pointed at the tip. The upper surface of the head forms a triangle, obtuse at the tip.

Some have the antennæ shorter than the head.

Otites, has the seta simple, and the lower part of the face is not produced.

Euthycera, Latr., has the seta plumose, and the lower part of the face produced into a truncated muzzle.

The others have the antennæ as long as, or longer than, the head.

Sepedon, Latr., has the antennæ evidently longer than the head, and the seta simple.

Tetanocera, Dum., has the antennæ as long as the head, and the seta sometimes plumose.

The sixth division, LEPTOPODITES, is remarkable for the length and slenderness of the feet, the hind ones being at least as long again as the body, which is also slender and filiform; all the tarsi are short. The head is spherical or ellipsoid, and terminated in a point. The antennæ are very small. They are found on plants, and many frequent aquatic places.

Micropeza, Meig., has the head ellipsoid, terminated in a point, and the seta of the antennæ simple. *Calobata filiformis*, Fabr.

Calobata, Fabr., has the head spheroidal, and the seta often plumose.

Nerius, Fabr., has the habit of Micropeza, but differs in the antennæ being as long as the head.

The seventh division, CARPOMYZÆ, has the wings vibratile, spotted with black or yellow, an appearance very like that of the Domestic Flies, but with the eyes apart, and the abdomen with four or five external segments, mostly terminated in the females by a cylindric or conic ovipositor; the antennæ always short, with the seta rarely villose. The larvæ of many species live in fruits or seeds, in the germ of which the parent fly had deposited its eggs.

Many species approach the preceding subgenera in the narrow and elongated form of the body, and long legs, as well as in the globular or more elongated form of the head.

Diopsis, Linn., distinct from the very elongated horns into which the sides of the head are produced, and the scutellum with two spines. These singular exotic insects have been monographed by Dalman, [and subsequently by me, in the *Transactions of the Linnæan Society*].

Cephalia, Meig., has the palette of the antennæ narrow and long, and the palpi spatulate.

Sepsis, Fall., has the palette much shorter, with a naked seta, and the palpi nearly filiform. [Small, active Flies, with wings spotted with black.]

The other Carpomyzæ have the appearance of Common Flies, with the head short and hemispherical, and the legs of moderate length.

The three following subgenera have the upper surface of the head almost horizontal, so that the antennæ appear inserted on a level with the top.

Ortalis, Fall., has the abdomen not terminated by an external ovipositor in the females. M. Fallen refers the *Musca cerasi*, Linn., to this subgenus, the larva of which generally feeds inside the fruit of the cherry, quitting the fruit and entering the earth when ready to undergo its transformations.

Tetanops, Meig., has an exserted ovipositor in the females, like a tail; the head, seen from above, appears nearly triangular.

Tephrites, Latr. (*Trypeta*, Meig.), has the abdomen similarly terminated, but the head is rather transverse than longitudinal, and rounded. *Musca Cardui*, Linn., the larva of which lives in galls, on the common thistle, on the substance of which it feeds.

Dacus, Fab., comprises those Tephrites which have the palette more elongate, including the species which attacks the olive. The inhabitants of the Isle of France are scarcely able to obtain any sound lemons, in consequence of the attacks of a species of this genus.

Platystoma, Meig., differs in having the head more compressed transversely, so that the upper surface is more slanting, and the antennæ appear inserted in the middle of the face.

This naturally conducts us to *Timia*, Wied., and *Mosillus*, belonging to the next division.

The eighth division, GYMNOMYZIDES, is composed of small *Muscides*, with a short body, curved, nearly glabrous, of a shining black colour, the head much compressed transversely, as in Platystoma, without any inferior prominence; the scutellum advanced; the abdomen short, depressed, and sometimes terminated by a small point, and the legs nearly glabrous.

Celyphus, Dalm. (having the scutellum extended over the body), and

Lauxania, Latr. (with the scutellum of ordinary size and the seta plumose), have the antennæ longer than the head. The others have them shorter.

In some of these they are very short and wide apart, and lodged in impressed fossulæ, the space between them being elevated.

Mosillus, Latr., has the first cell of the posterior edge of the wings almost closed; Meigen divides them into two subgenera,—*Timia*, with the abdomen 6-jointed, and *Ulidia*, with it 5-jointed.

Homalura, Meig., with the abdomen 5-jointed, and

Actora, Meig., with it 6-jointed, have the first cells of the posterior limb of the wings entirely open and longitudinal.

In others the antennæ are nearly contiguous, and the cells of the posterior edge of the wing are always open.

Gymnomyza, Fall., has the antennæ inserted beneath a sort of arch, and near the middle of the face.

Lonchæa, Meig., has them inserted higher, without any appearance of an arch.

The second section of the *Muscides*, and which forms our ninth and last sub-tribe, the HYPOCERA, consists of a single subgenus, distinct from all the preceding in many respects. The palpi are always external; the antennæ inserted near the oral cavity, very short, terminated by a large globular joint, with a very long seta; the wings have only three oblique discoidal nerves, whence the name *Trineura* given to them by Meigen; the legs are very short and spiny, with the thighs large and compressed, especially in the hind legs. They are extremely active, and form the genus *Phora*, Latr.; *Trineura*, Meig.

Our second general section of the Dipterous insects differs from the preceding in the mouth, antennæ, and transformations, and other less important characters; whence Dr. Leach was induced to form them into a distinct order, *Omaloptera*. Those which terminate this section have a certain relation with the hexapod wingless insects, composing our order of Parasites, or the genus *Pediculus* of Linnæus.

This section forms

THE SIXTH FAMILY OF THE DIPTERA,—

THE PUPIPARA (or the *Nymphipara* of Réaumur).

The head of these insects, seen from above, is divided into two principal portions, the posterior being the principal, supporting the eyes and receiving the anterior part in an emargination in front. This is also divided into two parts, the posterior being the largest, and supporting the antennæ at its sides; and the other constitutes the mouth organs. The inferior and oral cavity of the head is occupied merely by membrane, out of the extremity of which the sucker protrudes, arising from a small bulb, or advanced peduncle, composed of two setæ close together, and covered by two coriaceous, narrow, elongate and villose plates, which act as sheaths. Whether these valves represent, as I presume, the palpi of other Diptera, or whether they are pieces of a sheath properly so called, as regarded by M. Dufour, who has discovered two small bodies, which he takes for palpi; it is not less certain that the proboscis of these insects differs materially from that of the preceding Diptera, and that the proboscis has in this case more resemblance to that of the Fleas, from which it is, however, removed by the absence of articulations. In *Melophagus* the base of the plates of the sucker is covered by two small, coriaceous, triangular pieces, united, and forming a kind of labrum; they seem to represent, in a small degree, the two pieces which cover the base of the rostrum of the Flea.

The body is short, broad, flat, and defended by a solid or leathery-like skin. The head is more intimately united to the thorax than in the preceding families. The antennæ, always situated at the lateral and anterior extremity of the head, appear either under the form of a tubercle bearing three setæ, or that of small hairy plates. The size of the eyes varies, being very small in some species. In

general the pupiparæ are destitute of ocelli; the thorax is furnished with four spiracles, two anterior and two posterior; the latter pair, overlooked by Dufour, are situated, as in other Diptera, near the base of the balancers. The abdomen of *H. ovina* is furnished with ten spiracles, in the shape of small, round, corneous tubercles, the four posterior being close to the anus. The wings are always apart, and accompanied by balancers; their [fore-edge] is more or less margined with setæ; the superior nerves, which are nearest it, are strong and well defined; but those which extend to the hinder edge are weak, and not transversely united. In the terminal Diptera of this family these organs are wanting, or simply rudimental; the balancers are also obsolete. The legs are terminated by two robust claws, which have one or two teeth on the under side, which makes their appearance double or triple. The covering of the abdomen is continuous, so that this part of the body can be distended and acquire a considerable volume, as becomes necessary in the body of the female *Hippoboscæ*, for their larvæ are hatched and are nourished therein until the period of their transformation into pupæ. They are then discharged under the form of a soft, white egg, nearly as large as the abdomen of the female; the skin hardens, and becomes a solid cocoon, brown at first, but subsequently black; round, and often notched at one end, exhibiting a shiny plate or operculum, which becomes detached like a cap at the period of the final transformation. This cocoon has neither rings nor transverse incisions by which it is distinguished from those of other Diptera, especially the Athericera, which it most resembles. It is in the fine works of Réaumur, De Geer, Leon Dufour [and Lyonnet], illustrated as they are by figures in detail, that we must look for a complete account of these transformations, and of the changes which take place in the female at the period of her delivery. According to L. Dufour, the ovaries in their configuration and position singularly resemble those of the human female. The matrix, at first small, becomes enormously dilated, until it occupies the whole of the abdominal cavity.

These Diptera are known under the name of Spider-flies, and live almost exclusively upon some quadrupeds and birds. They run very quickly, and fly sideways.

Some, or the *Coriacea*, Latr., have the head distinct, and articulated with the anterior extremity of the thorax. They form the genus

HIPPOBOSCA, Linnæus.

Hippobosca proper, has wings, distinct eyes, and antennæ in the shape of tubercles, with three setæ on their upper side. *H. equina*, Linn., the Horse- or Forest-fly, a species common in some places on Horses, which it infests, especially fixing itself in great numbers beneath the tail.

Ornithomyia, Latr., has the antennæ in the shape of villose plates, and the nerves of the wings extending to the hind edge.

These insects form, in the monograph of Leach, four genera.

Feronia (*Nirmomyia*, Nitzsch.), distinct by the antennæ-like tubercles, and the claws of the tarsi double, and not treble.

Ornithomyia, with ocelli and tridentate claws, plate-like antennæ, and wings of large size, and rounded.

Stenepteryx, similar to Feronia, but with very long acute wings.

Oxypterum, with acute wings, but with the antennæ in the form of teeth, eyes small, ocelli wanting. They live on various species of Birds. *Hippobosca avicularia*, Linn.

Strebla, Wied., has the wings incumbent on the body, with longitudinal nervures united by some transverse nervures. The eyes are very small, and situated at the posterior angles of the head. Found on a South American species of Bat.

Melophagus, Latr. (*Melophila*, Nitzsch.), destitute of wings, and with the eyes scarcely distinct. *Hippobosca ovina*, [the common Sheep-tick].

A species of Melophagus, which lives on the Stag, exhibiting rudiments of wings, and with the thorax a little larger than the head, forms the subgenus *Lipoptena*, Nitzsch. Near Melophagus ought also to come the genus *Braula*, Nitzsch., of which the only known species lives on the Honey-bee, and is absolutely blind. Its thorax is divided into two transverse parts, and the last joint of the tarsi is furnished with a row of small bristles. Réaumur had long ago figured this, or a closely-allied animal.

The other Pupiparæ, *Phthiromyiæ*, Latr., have the head very small, or almost obsolete, forming near the anterior and dorsal extremity of the thorax a small body, which is elevated vertically. They compose the genus

NYCTERIBIA, Latr. (*Phthiridium*, Hermann),—

And have neither wings nor balancers, and more nearly resemble Spiders than Hippoboscæ. They live on Bats. Linnæus places the only species with which he was acquainted with the *Pediculi*. See the article *Nycteribia*, in the *Encyclopédie Methodique*, and in the *Nouv. Dictionn. d'Hist. Naturelle*, [and also my memoir in the *Transactions of the Zoological Society of London*, in which I have described numerous species].

THIRD DIVISION, CLASSES—CRUSTACEA, ARACHNIDA, AND INSECTA.

CRUSTACEA. (P. 407—448.)

The British Malacostracous Crustacea form the subjects of two valuable works; one, by Dr. Leach, in quarto, with beautiful coloured plates, representing each species of the natural size; and the other now in course of publication by Professor Thomas Bell, forming part of Mr. Van Voorst's beautiful series of works upon British Natural History.

An invaluable series of illustrations of the whole of the class Crustacea, has been published by Milne Edwards, in the Crochard edition of the Regne Animal.

The Crustacea of D'Orbigny's Voyage have also been more recently described and beautifully figured by Milne Edwards, and those of the voyage of the Samarang, by Mr. A. White (now in course of publication). Other new species have also been described by Mr. White in detached papers in the Annals of Natural History.

The periodical casting of the shell by these animals after their arrival at their adult form, led to the long-received opinion that they had not previously undergone any decided metamorphosis. The recent investigations of several authors have, however, clearly proved that the young fry in many species are quite unlike their parents, and that in fact they are the animals which had been previously considered as distinct Entomostracans, under the name of Zoea. It is singular, however, that the fry of the common Cray-fish (as observed by Rathke), and of the land Crabs, do not materially differ from the adult state.

A new and remarkable genus, named Calocaris by Professor Bell, belongs to the Decapod Macroura and subsection Astacini (p. 420), but with elongated limbs, a very thin crust to the body, destitute of all colouring pigment, and of corneæ in the eyes. C. Macandreæ, a species found in Loch Fyne and the Mull of Galloway, inhabits a depth of no less than 180 fathoms, where of course distinct vision would be useless and unavailing, which accounts for the rudimental character of the eyes, which are entirely white.

Dr. Erichson has recently published a memoir on the genus Astacus (p. 420), describing a number of additional species of Cray-fish from various parts of the world.

Several other new and interesting British genera allied to Mysis (p. 422), have been described by H. Goodsir in the New Edinburgh Philosophical Journal.

Zeuxo, Templeton in Trans. Ent. Soc. (*Z. Westwoodiana*); and *Crossurus* and *Liriope* of Rathke (Nova Acta, Vol. XX.) are small but remarkable genera closely allied to Rhæa, p. 428.

Many additional species as well as several new genera of Amphipoda (p. 429), have also still more recently been described by Rathke, in Nova Acta, Vol. XX., and in Kroyer's Tidsskrift; and in a very interesting genus named *Chelura terebrans*, which burrows into submerged wooden structures in the same manner as Limnoria, has also been described by Philippi in the fourth Volume of Wiegmann's Archives.

H. Goodsir has also added some new and very distinct British species of Amphipods in the Edinburgh New Philosophical Journal, Vol. XXXIII.

H. Goodsir has described a third species of Bopyrus (p. 431) in the Annals of Nat. Hist., Vol. XV., found beneath the carapace of Hippolyte ensiferus; and Rathke has described and figured, with all its details, a new allied genus named Phryxus, also found beneath the shells of different Macrourous Crustacea (Nova Acta, Vol. XX.) of which I possess a British specimen.

A very elaborate paper upon the destructive Limnoria terebrans (p. 432), has been published by Dr. Coldstream in the seventeenth volume of the Edinburgh New Philos. Journal.

Two additional British species of Arcturus (p. 433), have also been described by H. Goodsir.

The development of the eggs and young of Asellus aquaticus (p. 433), has formed the subject of a very elaborate memoir by Rathke, published in the second volume of the second series of the Annalés des Sciences Naturelles.

H. Goodsir has described several new British species of the singular genus Cuma (p. 437), as well as two new and allied genera, named Bodotria and Alauna, in the thirty-fourth volume of the Edinburgh New Philos. Journal.

Dr. Baird's Papers on different portions of the Entomostraca, published in the Annals of Natural History, must be consulted, and also a paper by the same gentleman, in the first volume of the Zoologist, upon other species which are luminous, and inhabit the ocean; including the genera Oithona and Cyclopsina. Amongst the minute luminous oceanic species, and probably, in the present order of Branchiopoda, must also be ranged the genus *Sapphirina* of Edwards, as well as several other minute species and genera recently described by Goodsir, peculiar for possessing a double eye in a single dark spot, with the body depressed as in the Isopoda, and the posterior thoracic legs double. They are very active in their habits, and swim about in company with other allied forms They constitute the genera *Zaus*, *Sterope*, and *Carillus*. The Oniscus fulgens of Tilesius seems to belong to the

same tribe. Here also appear to belong the genera *Hersilia, Psamatne, Thyone,* and *Peltidium,* described by Philippi in Wiegmann's Archives and in the Annals of Nat. Hist., Vol. VI.

The remarkable Evadne Nordmanni, has been added to the British funna by H. Goodsir, who has given some additional details of it in the thirty-third volume of the Edinburgh New Philos. Journal.

An excellent memoir upon the development of the eggs and larvæ of Caligus piscinus (p. 447), has been published by H. Goodsir in the thirty-third volume of the Edinburgh New Philos. Journol.

THE TRILOBITES. (P. 449—450.)

The question as to the structure, or even of the existence of locomotive organs in the Trilobites, still remains undecided; although the recent researches of several celebrated comparative anatomists lead to the belief that such organs did exist in the form of thin membranous plates, of which the nearest analogies occur in the genus Branchipus. Dr. Burmeister has especially treated upon this analogy in his fine work upon the Trilobites, of which a Translation has been published by the Ray Society. The relationship of these anomalous animals with other Articulata has also been insisted upon at great length by Dr. Buckland, in his Bridgewater Treatise. If in these respects we have not arrived at definite views, our knowledge of the species has greatly increased; whilst many new genera have also been defined. The most recent and comprehensive works on these fossil animals, are Dr. Burmeister's volume above referred to, Hawle and Corda's Prodrom einer monographie der Bohmischen Trilobiten, 4to. Prague, 1847; and Beyrich's Memoir über einige Bohmischen Trilobiten, Berlin, 1845.

A paper on the relations of these animals with other articulata, by Mr. W. S. Mac Leay, may also be referred to.

ARACHNIDA. (P. 450—471.)

Since the first edition of this Translation was published, the work of the Baron Walckenaer has been completed in four volumes, forming a most invaluable summary of our knowledge of the Apterous insects (exclusive of the Crustacea), the third volume containing the Phrynidæ, Scorpionidæ, Solpugidæ, Phalangiidæ, Acari, Pediculi, Pulicidæ and Thysanura, having been contributed by M. Paul Gervais. The Myriapoda, also described by M. Gervais, occupy half of the fourth volume; the remainder of which consists of additions to the whole work. As the additions to our knowledge of the Arachnida, consist for the most part of new genera characterized by diversities of structure, without any addition to our knowledge of the economy of the species on which they have been founded, we shall merely refer in this general manner to the sources where they have been described.

Many curious facts connected with the Natural History of different species of British Spiders, (Araneides p. 454), have been recorded by Mr Blackwall, who communicated an interesting paper on the subject to the British Association of Science, which has since been published in the Annals of Natural History. In one of his papers, published in the eighteenth volume of the Transactions of the Linnæan Society, he proposes to divide the whole of the Araneides into three primary groups, from the number of eyes—named OCTONOCULINA, eight-eyed; SENOCULINA, six-eyed; and BINOCULINA, two-eyed. Another paper by the same author, in the nineteenth volume of the same Transactions, contains descriptions of a great number of new British species.

An important memoir on the Physiology and Natural History of the Araneides, has been published by Menge, in the fourth volume of the Natural History Society of Dantzig.

The West Indian Mygale nidulans (p. 467), belongs to the genus Actinopus of Perty (Sphodros Walck.) Another closely allied species of trap-door spider was sent from Barbary by Mr. Drummond Hay, which I described in detail in the third volume of the Transactions of the Entomological Society of London. Mr. S. S. Saunders also described a new species of trap-door spider from Ionia, in the same volume, giving a detailed account of its habits

Mr. A. White, of the British Museum, has also described several new forms of exotic Spiders in the Annals of Natural History; and Mr. Adams has collected some interesting observations on the economy of various exotic species, which will be published in the zoological portion of the voyage of the Samarang.

The Scorpionidæ (p. 466), have recently formed the subject of a memoir published by M. Gervais, in the fourth volume of the Archives du Museum d' Histoire Naturelle. Eighty species are now known, and which are divided by this author into two groups and eight genera, Androctonus, Centrurus, Atreus, Telegonus, Buthus, Chactas, Scorpius, and Ischnurus.

The genus Galeodes (p. 467), has been revised by Koch in Wiegmann's Archives, and its species, twenty-nine in number, divided into various sub-genera. Captain Hutton and Colonel Hearsey have noticed the carnivorous habits of a large Indian species, (Ann. Nat. Hist., 1843.) The anatomy of the genus has been studied by Blanchard, (Comptes rendus, XXI.)

Koch (Arachniden X Band.), has described many new species and several new genera of Cheliferides, (p. 467), and Mr. Tulk has noticed a peculiarity in its anatomy, (Ann. Nat. Hist., XIII.) A very remarkable species has been found in the Mammoth Cave in Kentucky, and described by Tellkampf, (Wiegm. Arch , 1844.)

The Pycnogonidæ (p. 468), have been investigated by Kröyer, (Naturhist. Tidsskr., Vol. III, and new series, Vol. I), and several new genera and species proposed by Goodsir, (Edinburgh New Philos. Mag., XXXII, and Ann Nat Hist., XIV and XV). Also by Philippi (Wiegmann's Arch., 1843), and Quatrefages (Comptes rendus, XIX, and Annales Sci. Nat. third series, Vol. IV), has investigated their internal anatomy, with the view of determining their natural position.

The Phalangita (p. 469), have received many additional new species described by Koch (Arachniden), and Gervais. A remarkable blind species from Guinea, is described by Guérin, (Rev. Zool., 1838.) Mr. Tulk has

published a valuable memoir on the Anatomy of this group, in the twelfth volume of Annals of Natural History. The extensive tribe of Mites, Acarides (p. 469), has received great additions, especially by Koch and Gervais, the latter of whom has arranged the numerous genera of which it is now composed into seven groups, having for their types, the genera Bdella, Trombidion, Hydrachna, Gamasus, Ixodes, Tyroglyphus and Oribates. The Bdellides have been revised by Van Heyden and Koch; the water Mites, Hydrachnæ, Gamasi and Oribatides by Koch (Uebersicht, &c., Part III). And a valuable memoir on the Anatomy of the Acari, has been published by Dujardin. (Ann. Sc. Nat. third series, Vol. III.)

A singular discussion has been published in the Annals of the French Entomological Society, Vol. VIII, relative to a species of Oribates, regarded by M. Robineau Desvoidy as a Coleopterous insect, to which he gave the name of Xenillus clypeator. Another species of Mite has also been the subject of much discussion, it having been asserted by Mr. Weekes that it was developed by the means of galvanic action.

Several other species of great singularity have lately been described, which have also attracted much attention from their infesting the bodies of man and the higher animals; the Acarus folliculorum found within the pores of the nose, discovered by M. Simon, has been generically named Simonea by Gervais; Entozoon by Erasmus Wilson; and Demodex by Professor Owen. A second species has been described by Mr. Tulk, found upon a dog.

Another very singular animal described by Doyere, under the name of Tardigradus, found upon the ochre-coloured slime covering the eggs of frogs, and capable of being brought to life again, after being completely dried up, and which was long regarded as one of the Infusory Zoophytes, has more recently been considered as a very degraded type of the present tribe.

INSECTA IN GENERAL. (P. 471—472.)

SINCE the publication of the former edition of this translation, a great number of Entomological works have been published, in many of which the classification of the orders of insects laid down by Latreille, has been departed from;* the greater portion of these works, however, are treatises more or less extended, upon the various natural families or higher groups of insects, elaborated with great care; and which, in consequence of the vast additions to our collections received from distant countries, for the most part previously unvisited by the collector of insects, would render a complete revision of the work before us necessary, modifications in the arrangement of almost every group, often to a very great extent, having been proposed. It will be impossible of course, in a short supplement like the present, to do more than direct the attention of the student to the chief of these works, noticing where possible, and as concisely as can be, the more material alterations which have been proposed.

Of these recently published works, several of the most valuable consist of treatises which have appeared in the pages of periodical works expressly devoted to Entomology. These are the Transactions of the Entomological Societies of London and France; the Entomologische Zeitung of the Stettin Entomological Society; the Zeitschrift fur die Entomologie of Dr. Germar; the Linnæa Entomologica; and the Entomologist, edited by Newman; besides the more general periodicals, such as the Annals of Natural History; the Annales des Sciences Naturelles; the Revue Zoologique; the Zoologist; the Bulletin of the Natural History Society of Moscow; the Transactions of the Boston Society of Natural History; and the Linnæan Society of London; as well as of various Continental and American Societies and Academies.

Other works expressly devoted to the insects of various orders in general, or confined to separate localities, are also especially to be mentioned, amongst these are the insects of the Voyage of D'Orbigny, undertaken by order of the French Government, described by Brullé and Blanchard. The insects of the Canary Islands, by Webb and Berthelot; the insects of Algeria, collected and described by Lucas, and also published in the great French National Work on that country; the Arcana Entomologica, and the Cabinet of Oriental Entomology, published by the author of the present supplement; the insects of the Voyage of the Erebus and Terror, described by Mr. A. White; and the Indian insects collected by M. Delessert, described by Guérin Meneville.

The continuation of the great work of Panzer on the insects of Germany, by Koch and Herrich Schaffer, contains representations of a vast number of new species, and many new forms, especially among the more obscure tribes of insects. The insects of Van Diemen's Land and other parts of Australia, have been described by Erichson in his Archives; Dr. Germar in the Linnæa Entomologica; and

* This is singularly the case in a work on the natural arrangement of insects, by Swainson and Shuckard, published in the Cabinet Cyclopædia, to review which, would be a waste of labour. The same may be said with respect to the septenary system developed in Mr. Newman's Introduction to the History of Insects and System of Nature.

Mr. Hope in the proceedings of the Entomological Society. Those of Angola are described by Ericnson in his Archives; and those of Congo by White, in the Annals of Nat. Hist., Vol. XII. The last-named author, with Mr. Doubleday, has also described the insects of New Zealand in the supplement to Dieffenbach's Travels. Many new species from Cape Palmas, on the Gold Coast of Africa, are described by Mr. Hope in the Annals of Nat. Hist. The Symbolæ Physicæ contains a great number of species from Arabia and Egypt, beautifully figured and described by Dr. Klug. A great number of new species from the Himalayan regions of India, are described by Kollar and Redtenbacher in Hugel's Travels in Cachmere &c., lately published. Many new forms which it will be impossible for me to particularize in this supplement, are described and figured by Dr. Burmeister in his Genera Insectorum, recently completed. The insects of Russia, Siberia, &c., have been greatly investigated, and descriptions of them published by Fischer, Gebler, Kolenati, &c., in the Bulletin of the Moscow and Petersburgh Societies.

The investigation of the transformations and natural history of various insects, more especially such as are obnoxious to mankind by their devastations upon the products of the garden or orchard, or upon other materials, has especially been attended to within the last few years. A very beautiful work on the species injurious to forest and fruit trees, by Ratzeburg, has appeared in three volumes, 4to., with a great number of splendid plates. Another valuable work by Dr. T. W. Harris, has appeared in America, entitled a Report upon the Insects of Massachusets injurious to Vegetation, in one volume, 8vo.; whilst in our own country, a number of papers by Mr. Curtis, have appeared in the Journal of the Royal Agricultural Society of England, on the insects which attack the turnip, wheat, oats, barley, and other crops. The pages of the *Gardener's Chronicle* have also contained a series of articles upon Garden Insects, by Mr. Curtis and myself. Many papers on the Transformations of Insects, by Dufour, Perris, &c., have appeared in the Annals of the French Entomological Society. An annual series of reports on the Progress of Entomology, published by Dr. Erichson in his Archives and the Annual Addresses of the Presidents of the Entomological Society of London, contain a great fund of instruction, and must be referred to by every one wishing to keep *au courant* with the rapid progress of entomological science.

Various important memoirs on the Anatomy of Insects have also recently appeared, chiefly by Leon Dufour, especially his Anatomical and Physiological Researches upon the Hemiptera, Orthoptera, Hymenoptera, and Diptera, in two volumes, 4to., and many other detached memoirs by the same author, as well as several by Mr. Newport, in the Philosophical Transactions of the Royal Society. A series of anatomical monographs has also been commenced by Stein, the first of which is devoted to the female organs of generation in the Coleoptera; a memoir by the same author on the organs of generation of the Myriapoda, appeared in Müller's Archives, 1842. The uses of the Antennæ have also formed the subject of several memoirs by Duponchel (Revue Zoologique); Newport (Trans. Ent. Soc.); Goureau (Annales Ent. Soc. France); and especially by Erichson, in his excellent Dissertatio de Fabrica et Usu Antennarum in Insectis, Berlin, 1847, 4to., in which the opinions that these organs are instruments of smelling, is maintained and supported by their minute anatomy.

A paper upon the animals found in the underground Mammoth Cave in Kentucky, by Dr. Tellkampf, announces the singular fact, that most of the insects found in this locality are either entirely blind, or have the eyes almost rudimental; and the same fact has also been discovered by M. Schiodte with respect to a number of insects found in the caves of Adelberg, in Styria, inhabited by the Proteus.

Another curious circumstance affecting a considerable number of species of different orders, has lately formed the subject of numerous articles by different German writers, namely, the connexion which exists between these insects and ants, in the nests of which they are generally found. Such has also been found to be the case with the singular beetles forming the family Paussidæ.

Two papers by the Rev. F. W. Hope, upon insects which infest the interior of the human body, and on the various species used as food by man, are worthy of notice in this place.

The discovery of great numbers of fossil species of insects in different parts of Europe, has also led to the publication of several works on this branch of the subject, especially Mr. Brodie's History of the Fossil Insects, in the Secondary Rocks of England; a paper by Dr. Germar, in the Nova Acta, and a work by O. Heer on the Insects of Œningen; and by Unger and Charpentier on those of Radoboj in Croatia. Mr. Hope has also published a paper on fossil insects in Trans. Ent. Soc. London, Vol. IV.

THE ORDER MYRIAPODA. (P. 482—486.)

The classification as well as the characters of this tribe of insects has advanced towards perfection with rapid steps since the days of Latreille; although Naturalists are still as much at variance with respect to their real relations. Thus, whilst M. Brandt adopts the views of Latreille, and even M. Gervais (Hist. Nat. Ins. Apt., III, p. 54), seems inclined to prefer regarding them as vermiform insects rather than as forming a separate class, equal in value to the Insecta, Arachnida and Crustacea, Mr. Newport, taking up the views of Strauss, (Cons. gener. sur l'anat. des an. art. p. 16) and some earlier authors, considers them as most nearly allied to the Annelida, placing the sub-kingdom Articulata at the head of the Invertebrata, commencing with the Hexapod insects, followed by the Spiders, Crustacea, Myriapoda, Annelida, and the remainder of the Articulata, (Trans. Linn. Soc., XIX, 271.)

The three authors above-mentioned, Brandt, Newport, and Gervais, have especially studied these insects. Newport has retained the binary division and names Chilognatha and Chilopoda of Latreille, but Gervais has adopted the views of the Baron Walckenaer, and employed the name of Diplopoda for that of Chilognatha.

The arrangement of Mr. Newport of the class given in the Linnæan Transactions is as follows:—

Order I.—Chilopoda Latr; Syngnatha Leach.
- Tribe 1. Schizotarsia; Fam. 1. Cermatiidæ, 1 genus.
- Tribe 2. Holotarsia; Fam. 2. Lithobiidæ, 2 genera.
  - Fam. 3. Scolopendridæ, 8 genera.
  - Fam. 4. Geophilidæ, 5 genera.

Order II.—[Diplopoda Walckenaer]; Chilognatha Latreille, Newport.
- Tribe 3. Pentazonia; Fam. 5. Glomeridæ, 3 genera.
- Tribe 4. Monozonia; Fam. 6. Polyxenidæ, 1 genus.
  - Fam. 7. Polydesmidæ, 6 genera.
- Tribe 5. Bizonia; Fam. 8. Julidæ, 8 genera.
  - Fam. 9. Polyzonidæ, 2 genera.
  - Fam. 10. Siphonophoridæ, 1 genus.

The works of the authors above mentioned, must be referred to not only for descriptions of the 300 known species of the order, but also for many valuable observations on their structure, anatomy, and development from the egg state, as well as a memoir by M. Waga, on the Myriapoda of the environs of Warsaw; various detached memoirs by M. Lucas; the article Myriapoda by R. Jones, in Dr. Todd's Cyclopædia of Anatomy and Physiology. Also a memoir on the genus Scutigera Lam. (Cermatia Illiger), published by R. Templeton, in the Transactions of the Entomological Society of London, Vol. III; and a memoir by Mikan, on the Iuli of South America, published in the Isis for 1834.

In the Supplement to the 4th Volume of the Histoire Naturelle des Insectes Apteres, the Baron Walckenaer has introduced a new mode of discriminating the difficult species of the genera Heteristoma and Scolopendra, by the number of joints in the Antennæ, varying from twenty-five to eleven.

THE ORDER THYSANURA. (P. 486—488.)

The researches of the Abbé Bourlet on the Thysanuræ of the North of France, and of M. Nicolet on those of Neufchatel in Switzerland, must be consulted. The former have been published in the Memoirs of the Societies of Lille, (1839), and of Douai, (1843), and the Revue Zoologique, 1845; and the latter in the Memoires de la Société Helvet. des Sci. Natur, 1842, and in the Annales of the French Entomological Society for 1847. These works, (except the last), with various detached articles on the subject, have been employed by M. Gervais in his work on these insects, introduced into the 3rd Volume of the Hist. Nat. des Apteres, in which the genus Podura is divided into eight groups or sub-genera, several of which have received synonymical names by the different authors above named. Several other genera are added in M. Nicolet's last memoir.

The Lepismenæ have received the addition of two singular genera, Nicoletea and Campodea, both having the body destitute of scales, and very much resembling the larvæ of Staphylinidæ.

The relations of this order have also been the subject of consideration; Burmeister ranging them next to the Orthoptera, whilst Gervais regards the Lepismidæ as Neuropterous insects stopped in their development.

THE ORDER PARASITA. (P. 488.)

The fine Monograph of Mr. Denny upon the British species of Parasita, has materially increased our knowledge of these insects; a great number of species being for the first time described and beautifully figured in the twenty-six plates with which the work is illustrated. The species are here arranged according to Nitzsch's distribution, as published in Germar's Magazine, one sub-genus only being added for the reception of the species found on the common Swift, and named Nitzschia Burmeisteri. Burmeister's articles on this order in his Genera Insectorum, must be consulted, as well as a valuable article on the structure of the mouth of the Pediculi, in the Linnæa Entomologica by the same writer.

THE ORDER SUCTORIA. (P. 489.)

A summary of the species of Pulex has been given by Gervais, in the 3rd Volume of the Histoire Naturelle des

insectes Apteres, the last of which (Mycetophila nigra Haliday), must, however, be expunged, being a Dipterous insect, compared by Mr. Haliday with Pulex. Several detached species have also been published by Denny, Kirby, Bouché, Macquart, and Guérin.

THE ORDER COLEOPTERA. (P. 491).

This order of insects has lately received a much greater share of attention and examination than any other, a considerable number of detached memoirs or special works having been published either upon local species, or upon particular families. Several memoirs have also appeared with reference to the general arrangement of the order. Thus the disposition of the veins of the wings has been studied by Burmeister (in his article on Paussus), and by Heer (Entomol. Zeit., 1843), with a view to its affording a satisfactory plan of arrangement; whilst the numerical development of the segments of the abdomen has also been studied by Heer (in the same work), and by Schiodte (in Germar's Zeitschrift, Vol. V.) with the same view.

The investigation of the preparatory states of the Coleoptera has been continued by Dr. Erichson, who has published several articles on that branch of the subject in his Archives.

A general catalogue of the order has been published by Sturm, on the plan of Dejean's catalogues, but such a work requires annual supplements, from the great number of species which are continually described.

The Coleoptera of Europe are illustrated by Kuster in Die Kafer Europas.

The Coleoptera of our own country have been described by Stephens in the Manual of British Beetles, and outline figures of each genus, published in Spry and Shuckard's British Coleoptera. The beautiful work of Sturm on the Coleoptera of Germany (Deutchslands Fauna), is still continued at intervals. A valuable little work on the genera of the Coleoptera of Germany, has also been published by Redtenbacher. A more important work, however, on the Coleoptera of Germany, is now in course of publication by Dr. Erichson,* who enjoys ample opportunities for determining most of the continental species. Moreover, in this work, the author has added notes of the characters, and tables of the allied exotic genera. The work of Schiodte on the Coleoptera of Denmark, illustrated with numerous anatomical plates and generic details, must also be consulted, as well as that by Heer on the Coleoptera of Switzerland. The Coleoptera of Russia, Siberia, &c., have been described by Faldermann, Gebler, Motchoulsky, Mannerheim, Fischer, &c., in the Petersburgh and Moscow Transactions.

The extra European Coleoptera has also been recently much investigated. Those of India, by Kollar and Redtenbacher; those of Sylhet, by Mr. Hope (Trans. Linn. Soc.); those of Assam, by Hope and Parry; those of Canton and Chusan, collected by Dr. Cantor, by Mr. Hope, in the Proceedings of the Entomological Society; those collected at Hong Kong by Mr. Bowring, by Mr. White, in the Annals of Natural History; those of Western Africa, by Hope, Imhoff and Erichson; those of Port Essington and Port Philip, by Hope, (Proc. Ent. Soc.), and Newman (Entomologist); those from Adelaide, by Dr. Germar; those from Van Diemen's Land, by Erichson; those of the Mozambique, by Bertolini; those collected by Captain King in his voyage to the Straits of Magellan, by Mr. Curtis (Linn. Trans. Vol. XIX.); those of the Aleutian Islands, by Count Mannerheim; and many fine species brought from the southern parts of South America, by Mr. Charles Darwin, have been described by Waterhouse, in the Annals of Natural History; many of the Coleoptera of North America have been described by Leconte, Haldemann, and others, in the Transactions of the Boston Natural History and Philadelphia Societies. Mr. Hope's Coleopterist's Manual, in Three Volumes, 8vo., contains descriptions of many new species, and various excellent remarks on the species described by Linnæus and Fabricius. I have also just received the first part of Bohemann's work on the Coleoptera of Caffraria.

The tribe CICINDELETÆ (p. 493), has been revised by Lacordaire in the memoirs of the Royal Society of Liege, Vol. I, in which the author divides it into five families—1. Manticoridæ with four genera. 2. Megacephalidæ with seven genera. 3. Cicindelidæ with sixteen genera and sub-genera 4. Collyridæ with three genera. 5. Ctenostomidæ with four genera. Many new species of this tribe have been described by Reiche, Hope, Parry, Kollar, Chevrolat, the Marquis de la Ferté; and several new genera by Germar, Guerin, and Chaudoir, amongst which the most remarkable are Dromochorus and Callidema from Central America. The work of Schmidt Gobel on the Insects of India, and Chaudoir's memoir on these insects just published, also contain many new species.

The tribe CARABICI (p. 494), has, notwithstanding the great work of Dejean, received considerable additions, as *well as suggested modifications in its arrangements.* Mr. *Haliday has proposed that the variable insertion of the* second spur of the fore tibiæ may be replaced to better purpose by the character which the structure of the sternum offers, and which appears to afford a more precise line of demarcation. If adopted, the tribe will fall into three primary groups. (Entomologist, p. 186.)

I. *Amphibii*, Præsternum dilated and truncated, forming a continuous level with the Mesosternum, (viz., the structure of Haliploini), Gen. Omophron.

II. *Abdominales*, Mesosternum in front with a short, longitudinal ridge received into the posterior cavity of Prosternum, limiting the motion of the prothorax, and giving rigidity to the frame, (approaching the structure of the Dyticidæ in general). Genera, Cychrus, Carabus, Calosoma, Leistus, Nebria, Notiophilus.

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* We have received intelligence, during the progress of this Supplement through the Press, of the decease of this most excellent author.

III. *Pedestres*, Mesothorax in front, contracted; retiring from the prosternum and permitting a freer motion of the prothorax, approaching the structure of the Cicindelidæ; including the Harpalidæ, Scaritidæ, and Brachinidæ of Mac Leay.

The Carabici of Denmark have been carefully revised by Schiodte.

The Premices Entomologiques of Putzeys (Mem. Soc. Liege, Vol. II), contains a monograph of Pasimachus, and an allied genus and a great number of new species belonging to this tribe. The same author has also more recently published a very extensive monograph on the genera allied to Clivina.

A remarkable genus allied to Procrustes from Xanthos, has been described by White (Ann. Nat. Hist. Vol. XV). Various new African species allied to Anthia are described by Bertoloni, the American species allied to Scarites subterraneus, by Le Comte, (Boston Journal); and many new Russian species by Kolenati (Meletemata Entomologica). A group of small extent, but very singular structure, and remarkable for the strong resemblance to aquatic beetles, has been proposed under the name of Heteromorphidæ to include the American genus Drepanus, and the Australian Adelotopus and Silphomorpha (Westwood in Linn. Trans. Vol. XVIII). The Carabidæ of the Voyage of the Beagle, collected by Mr. C. Darwin, have been described by Waterhouse in various papers in the Annals of Natural History. The Scaritidæ of New Holland, several of which are of singular beauty, have been illustrated in my Arcana Entomologica, and the Australian Promecoderi, by Guérin, (Revue Zool.); the Carabici of India are carefully described by Schmidt Gobel in the first part of his work upon the collection in the Museum of Prague; the species allied to Helluo (p. 495), have been revised by Reiche, and divided into nine genera. (Annales of the French Ent. Soc.) Many additional exotic genera and species have also been described by Bohemann and by Chandoir, in the Bulletin of the Moscow Society, 1842 and 1843. Hope, Newman, Lucas, Chevrolat, Menetries, Gebler, Redtenbacher, Erichson, White, and others, have also described many new detached species and genera. The species of California and Sitka have been monographed by Mannerheim, and those of Columbia by Reiche. The British species have been revised by Schaum, in the Entomol. Zeitung. Amongst the most remarkable of these new genera, is Anopthalmus of Sturm, founded on a blind species which inhabits the Luegger Caves, in Krania. A second blind species was also found in the Mammoth Cave in Kentucky, by Tellkampf.

The family DYTICIDÆ (p. 504), has received some additions of Danish species by Schiodte, in "Danmark's Eleutherata." The species found near Erlangen have been monographed by Rosenhauer, and various detached species have been described by other authors. The singular external marks of distinction in the sexes of some of the species have been described by Count Mannerheim; and Dr. Schmidt has investigated the causes of the sound emitted by Pelobius Hermanni. Dr. Schaum has revised the British species, and also published notes on the synonymy of many of the European ones in the Entomol. Zeitung.

The GYRINIDÆ, (p. 506). The German species have been revised by Suffrian (Entomol. Zeit.), and Von Keisenwetter has published some interesting observations on the habits of Orectochilus Villosus in the same work.

The BRACHELYTRA (p. 506), have received great additions since the first edition of this work. Erichson's Genera and Species Staphylinorum has been completed in two 8vo. volumes. In this work, the Brachelytra are divided into eleven primary tribes, characterized chiefly by the conspicuous or hidden position of the breathing pores of the prothorax, the insertion of the Antennæ, the form of the anterior and posterior coxæ, and of the posterior trochanters. These tribes are named from their typical genera.—1. Aleocharini; 2. Tachyporini; 3. Staphylinini; 4. Pæderini; 5. Pinophilini; 6. Stenini; 7. Oxytelini; 8. Piestini; 9. Phlæocharini; 10. Omalini; 11. Proteinini. The Linnæan species of this tribe have been revised by me in an article published in the Transactions of the Entomological Society. Mr. Holme has also published some interesting notes in the 3rd Volume of the same work; and Mr. Haliday has published some valuable "Notes on the Staphylinidæ," in the Entomologist. The numerous species of this tribe which reside in ant's nests, have formed the subject of many papers in Germar's Zeitschrift, and in the Entomol. Zeitung by different authors. Numerous species from Sitka Island, are described by Count Mannerheim; others from Angola by Erichson; and others from New Granada by Guérin. The German species have been revised by Kiesenwetter, in the Entomol. Zeitung. An excellent article on the curious genus Micralymma Westw., has also been published by Schiodte, (Linnæa Entomol.)

The BUPRESTIDES (p. 508), have been enriched with many new and beautiful exotic species by Spinola, Guérin, Chevrolat, Buquet, Erichson, Lucas, and White. The transformations of various species have been described by Pechioli, Lamotte Barace, Lucas, Leon Dufour, and Bertolini. A discussion on the structure of these larvæ between L. Dufour, Goureau and Blanchard, has been published in the Annals of the French Entomol. Society.

The splendid (but as regards its generical anatomical details, carelessly executed) work of Gory and Laporte, has been brought to a conclusion, and a review of it been published by Spinola in the Revue Zoologique.

The ELATERIDES (p. 510), have undergone an extensive revision by Germar and Erichson, in the Zeitschrift fur die Entomologie. The luminous species allied to E. Noctilucus, of which the number is now known to be considerable, have been formed into a separate genus named Pyrophorus. Various detached exotic species have been described by different authors. The splendid genus Campsosternus, and the remarkable gigantic species with flabellate antennæ, have been monographed by Mr. Hope in the Trans. Entomol. Soc., and Proceedings of the Zool. Society; and some very beautiful Indian species have been figured in my Cabinet of Oriental Entomology. The Natural History of many species injurious to the Agriculturist, has been published by Mr. Curtis in the Journal of the Royal Agricultural Society.

The sub-genera allied to Galba and Eucnemis (p. 510), have been revised by Guérin in the Annals of the French Entomological Society, in which the species, all of which are highly interesting, are divided into seventeen genera.

The CEBRIONITES (p. 511), have been investigated with much care by M. Guérin, in the first three numbers of

his Species et Iconographie des Animaux Articulés, in which careful figures, with dissections, are given of the genera Rhipicera, Sandalus, Scyrtes, Eucinetus, Ptyocerus, Selasia, Chamærhipis, Basodonta, Elodes, Bradytoma, Octoglossa and Cladotoma, all of which are accompanied by excellent monographs.

The LAMPYRIDES (p. 511), have received an additional number of new species, and several new genera, including Anisotelus, Hope, and Podistra and Thelodria, Motchoulsky. The species allied to Lycus (p. 511), have been examined by Erichson in his Zool. Archives.

The light of the glowworm has formed the subject of articles by Peters in Müller's Archiv., by Matteuci (in a letter to M. Dumas), and by Deickhoff (Entomol. Zeit., 117.)

The genus Malachius, Fabricius, belonging to the tribe MELYRIDES (p. 513), has been monographed by Dr. Erichson, who has described a great number of new species; the whole being divided into sixteen different genera. (Entomographien, Part I.)

The *Clerii* (p. 513), have received considerable additions, and have been monographed both by Dr. Klug, and the Marquis Spinola, the latter of whom has figured every species known to him ; but Dr. Klug has been able, from the rich stores of the Berlin Museum, to describe and figure a great number of species not contained in Spinola's work. Dr. Klug has adopted only twelve genera in the tribe regarding most of the groups of Laporte, Spinola, Chevrolat, Newman, &c., as sections. The genera adopted, and the number of species in each, respectively contained in the Berlin Cabinet, are as follows :—Cylidrus, five species ; Tillus, twenty-eight species ; Priocera, four species ; Clerus, seventy species ; Ptychopterus Klug (a new genus), one species from Caffraria ; Axina, one species ; Opilus, nineteen species ; Erymanthis Klug (a new genus), one species from Caffraria ; Trichodes, twenty species ; Corynetes, nineteen species ; Cylistus Klug (a new genus), one species from Caffraria ; and Enoplium, fifty species—Total, 219 species, of which, more than half are new. A supplement contains descriptions of fifty-nine other species, described by previous authors, and not seen by Dr. Klug. The following is a summary of the geographical range of the species—120 are natives of the New World, and ninety-nine of the Old. Of the Asiatic species, only four are from India ; one from Ceylon ; and six from Java. Of the African species only two are from Central Africa, but eight are described in the supplement from Senegal ; seventeen are from Madagascar ; twenty-three from South Africa ; and two from Arabia. Only eight species are contained in the Berlin Museum, from New Holland, but fourteen others are given in the supplement described by other writers. The English collections are much richer in the Asiatic and New Holland species. A number of the latter have been described by Mr. Newman. M Chevrolat has also described a number of additional new species from various localities, in the Annals of the French Entomological Society, and Revue Zoologique. The generic arrangement of M. Spinola appears to me far from satisfactory.

The Scydmænidæ (p. 515), have been studied by Schaum, who has published memoirs upon the family in his Analecta Entomologica, and in Germar's Zeitschrift, and in the Entomologische Zeitung ; and Chaudoir has described the Livonian species in the Bulletin of the Moscow Society.

The Histeroides of North America have been monographed by Leconte, accompanied by a series of outline figures very carefully executed.

The Silphales (p. 516), have been investigated particularly in respect to their anatomical details by Matzek, in his Necrophororum particula prima, Breslaw, 1839, and by Schmidt in his Inaugural "Dissertatio Silpharum monographiæ particula prima," Warsaw, 1841. Some curious genera apparently allied to this tribe, have been described and figured, but not in a sufficiently precise manner, by Motchoulsky, in the Bulletin of the Moscow Society.

A blind insect belonging to this family, found in the Mammoth cave in Kentucky, has been described under the name of Adelops, by Tellkampf, in Wiegmann's Archives.

The Nitidulariæ (p. 517), have been revised by Erichson, in Vol. XV. of Sturm's German Fauna, and in Germar's Zeitschrift, Vols. IV and V, where the tribe is divided into six primary groups, and a number of new genera added, founded chiefly upon exotic insects. The Engidites and Dermestini have been also revised by the same author, in his work on the Coleoptera of Germany, now in course of publication.

The Byrrhii (p. 519), have been monographed by Steffhany in Germar's Zeitschrift, Vol. IV, where several new genera are proposed.

The Acanthopoda (p. 519), consisting of the single genus Heterocerus, has been monographed by Von Kiesenwetter in Germar's Zeitschrift. Vols, IV and V, where twenty-five species are described. A monograph on the genus Georyssus, is given by Motchoulsky in the Moscow Transactions, 1841.

The Palpicornes (p. 520), have been very carefully investigated by M. Mulsant, of Lyons, who has published a treatise upon them in his work on the French Coleoptera. In this work the Palpicornes are divided into two primary sections.

1. The HYDROPHILIDES, having the basal joint of the tarsi of the hind legs shorter than the second joint.

Fam. I.—Sperchéens, consisting of the genus Sperchius, with one species.

Fam. II.—Helophoriens, genus Helophorus, eight species ; Hydrochus, five species ; Ochthebius, eleven species Hydræna, seven species.

Fam. III.—Hydrophiliens, genus Limnebius, four species ; Berosus, four species ; Hydrophilus, one species ; Hydrous, two species ; Hydrobius, three species ; Laccobius, one species ; Helophilus, one species ; Philhydrus, two species ; Cyllidium, one species.

2. The GEOPHILIDES, with the first joint of the hind tarsi longer than the second.

Fam. IV. Spheridiens. Genus Cyclonotum, one species ; Sphæridium, two species ; Cercyon, fifteen species ; Pelosoma, one species ; Megasternum, one species ; Cryptopleurum, one species.

The family LAMELLICORNES (p. 521), has received very numerous and valuable additions, several works

having been recently published especially devoted to this great tribe of insects. Of these, the most important are the volumes devoted to the Lamellicornes, in Mulsant's Histoire Naturelle des Coléoptères de France, and Dr. Burmeister's Handbuch der Entomologie, Vols. III, IV, and V. Mulsant adopts the two groups of Scarabæides or Petalocerides, and Lucanides or Priocerides, and divides the former into eight families, from the structure of the perfect insect and larva, namely—the Copriens, Aphodiens, Trogidiens, Geotrupins, Oryctesiens, Calicnemiens, Melonthens, and Cetoniens. These families are chiefly characterized by the position of the legs, the exposed or concealed scutellum and terminal segment of the body; the texture and position of the mandibles; form of the prosternum and number of joints in the antennæ. A more interesting plan of distribution of the Lamellicornes derived from the habits of the insects, is also given by Mulsant as follows:—

1. Coprophages, feeding upon excrementitious or stercorarious matters.
   - *a.* Copromorges, deriving their subsistence from the more succulent portions of excrementitious matters. (Copriens, Aphodiens.)
   - *b* Xerophages, feeding on dry animal or partially decomposed vegetable matter. (Trogidiens.)
   - *c.* Coprophages, devouring excrementitious matters. (Geotrupins.)
2. Saprophages, feeding upon decomposed vegetable matters. (Oryctesiens.)
3. Phyllophages, devouring leaves, divided into
   - *a.* Phytobies, feeding chiefly upon decomposed vegetables. (Calicnemiens.)
   - *b.* Phyllophages, leaf-eaters. (Melolonthins.)
   - *c.* Anthobies, feeding upon the petals of flowers. (Hopliæ.)
4. Melitophiles, feeding on the honey of flowers, divided into
   - *a.* Dendrobies, generally residing upon trees. } Cetoniens.
   - *b.* Melitophiles, generally feeding upon the honey of flowers. } Cetoniens.

Dr. Burmeister's plan of arrangement differs from that of any of his predecessors, by the introduction of the Lucanides into the midst of the other Lamellicornes, and by reversing the order of the groups. His plan of distribution, given in Vol. III of his Handbuch der Entomologie, is as follows:—*

1. Thalerophaga, divided into *a* Melitophila, *b* Anthobia, *c* Phyllophaga.
2. Saprophaga, divided into
   - A. *d* Xylophila; *e* Pectinicornia; and *f* Arenicolæ.
   - B. *g* Stercoricolæ, *h* Coprophaga.

Many excellent remarks upon and descriptions of new species of the Lamellicornia will be found in Mr Hope's Coleopterist's Manual, and in the text of Guérin's Iconographie du Regne Animal.

The typical Coprophaga with the middle legs wider apart than the rest (p. 522), have been revised by Reiche in the Annals of the French Entomological Society, and various additions thereto made by myself in the Transactions of the Zoological and Entomological Societies of London; in which I have also described various species from New Holland. Others from the same country have also been described by Hope (Proc. Ent. Soc.), and by Erichson in Wiegmann's Archives.

The Phanæi have been divided by Klug into thirteen groups, in the Proceedings of the Berlin Academy in 1841. The same author has described various African Ateuchi in his splendid Symbolæ Physicæ.

The Coprophagi, with the legs inserted at equal distances apart, have been carefully investigated by Mulsant in his work on the Coleoptera of France, by whom the family Aphodiidæ is divided as follows:—

1st Branch, Aphodiaires. Divided into three groups:—

- A. The Aphodiates composed of ten genera. 1. Colobopterus (A. erraticus); 2. Coprimorphus (A. scrutator); 3. Eupleurus (A. subterraneus); 4. Otophorus (A. hæmorrhordalis); 5. Teuchestes (A. Fossor); 6. Aphodius (A. scybalarius, and thirty-four other species, including a great number of named varieties); 7. Acrossus (A. rufipes Linn. and four other species); 8. Melinopterus (A. prodromus, contaminatus, and two other species); 9. Trichonotus (A. scropha); 10. Heptaulacus (A. sus and two other species.)
- B. The Ammæciates, comprising the genus 11, Ammæcius (A. elevatus).
- C. The Pleurophorates composed of five genera. 12. Plagiogonus (A. arenarius) 13. Oxyomus (A. porcatus); 14. Platytomus (A. sabulosus, new species); 15. Pleurophorus (A. cæsus); 16. Rhyssemus (A. asper and one new species.)

2nd Branch, Psammodiaires containing the two genera Diastictus (A. sabuleti) and Psammodius (A. sulcicollis and another species).

The genera Euparia, Ryparus, Chætopisthes, and Corythoderus are singular exotic genera allied to Aphodius, described by myself in the Trans. Ent. Soc., Vol. IV., and by Dr. Klug in the Symbolæ Physicæ.

The Arenicoli (p. 523), with exserted mandibles and ten-jointed antennæ, have been revised by myself in the Transactions of the Entomological Society, in which many new genera are described. A beautiful mongraph of the Athyrei and Bolbocerata has been published by Dr. Klug in the Berlin Transactions, and a number of additional species by myself in a paper read before the Linnæan Society. All the species are exotic, and of great variety and singular forms. The Acanthoceri have also been monographed by Germar in his Zeitschrift.

Mæchidius (p. 524), placed in the Trogidæ by M'Leay, belongs to the Melolonthidæ and Cryptodus (p. 524), which Mr. M'Leay gave in his paper on the Cetoniidæ of Southern Africa as the type of the Cremastocheilides,

* This distribution has been modified in his Fifth Volume so as to unite the Xylophila with the Thalerophaga, (under the new name Phaneropyga), leaving the four remaining families of the Saprophaga together, under the new name of Stegopyga.

belongs to Latreille's Xylophili. See my papers on these two genera in the fourth volume of the Transactions of the Entomol. Soc. of London.

The Xylophili (p. 524), have been entirely revised by Dr. Burmeister in his Handbuch der Entomologie, and a great number of new genera and species described. His distribution of the Xylophili is as follows :—

Section 1. Head in both sexes unarmed or with a minute tubercle.

Families 1. Cyclocephalidæ (corresponding with the genera Hexodon and Cyclocephala, placed by Latreille at the head of the Rutelidæ, with numerous additional allied genera) ; 2. Strategidæ (composed of eleven genera, chiefly described by Kirby and Hope.)

Section 2. Head of the males, horned or tubercled.

Families 3. Phileuridæ, 4. Oryctidæ, 5. Dynastidæ, 6. Agaocephalidæ, each being typified by the genus of the same name, but now divided into numerous genera and with great additions. 7. Amphibola, consisting of the three new anomalous genera, Pantodinus, B. Cryptodontes Dej (Leptognathus Westw.), and Xenodorus De Breme.

The Dynastidæ have been further illustrated with figures in Dr. Burmeister's Genera Insectorum, whilst Latreille's second division (Rutelidæ) has been revised in his Handbuch and divided into seven families—Chasmodiidæ, Macraspididæ, Parastasiidæ (typified by Parastasia Westw. a singular Eastern genus) Rutelidæ, Pelidnotidæ, Chrysophoridæ, and Areodidæ. The genera allied to Chrysophora have also been investigated by Guérin (Revue. Zool. 1844), and some beautiful species figured by Sturm in his new Catalogue of the Coleoptera.

The genera allied to Anoplognathus have also been monographed by Dr. Burmeister, who has divided them into two families—Anoplognathidæ and Geniatidæ : the former consisting of four sub-families—Anoplognathi genuini, Platycoeliidæ, Brachysternidæ, and Adoretidæ ; and the latter into the Leucothyreidæ and Geniatidæ genuinæ.

The Melolonthides have been carefully studied by Mulsant, who has divided them into fifteen genera divided into four branches, namely, the Melolonthaires, Sericaires, Anomalaires, and Hopliaires.

Dr. Burmeister's great division, Phyllophaga, is of wider extent than that so named by Latreille, being formed of two primary groups characterized primarily by the structure of the claws of the tarsi and named Phyllophaga Systellochela and Ph. Chænochela. The first of these groups is also divided into two sections,

A. Farinosæ, having the body generally covered with scales and composed of four families, 1. Heterochelidæ, 2. Gymnolomidæ, 3. Lepisiidæ, and 4. Hopliadæ.

B. Metallicæ, also composed of four families, 5. Anisopliadæ (including Anomala, Euchlora, Mimela, &c.), 6. Rutelidæ (divided as above mentioned into seven sub-families) ; 7. Anoplognathidæ (divided as above mentioned), and 8. Geniatidæ.

The second group Chænochela has not yet been published by Dr. Burmeister, but it includes the Melolonthæ and other genera forming the first half of Latreille's Melolonthides.

A number of genera allied to Melolontha, collected by Mr. C. Darwin, has been described by Mr. Curtis in the nineteenth volume of the Linnæan Transactions, and others from New Holland by Dr. Erichson. A monograph of the genus Popillia is publised by Newman in the Trans. Entom. Soc.

Some splendid insects of doubtful affinity, having Scarabæus longimanus for the type, have been formed by Mr. Hope into a family Eucheiridæ. It has been considered by Mr. Hope as allied to the Dynastidæ, by Klug and Erichson to the Melolonthidæ, and by Burmeister to the Trichii. Figures of both sexes of two of the most remarkable species (Mac Leayii and Dupontianus) with details, are given in my Cabinet of Oriental Entomology.

The splendid section of the Melitophili has received many fine additions, and the synonymy of the species described by previous authors, especially those contained in Gory and Percheron's monograph, has been thoroughly sifted. The chief works to which (in addition to those noticed in our former edition) reference must be made, are Dr. Burmeister's Handbuch der Entomologie, to numerous papers by Dr. Schaum published in the Annals of the French Entomological Society, in Germar's Zeitschrift, and separately, and to my Arcana Entomologica, in which the Goliathides have been especially illustrated, and many new forms described and figured. A number of new species of Melitophili have also been described by Hope and Schaum in the Transactions of the Entomolog. Soc. of London. The Cremastocheilides have also been carefully illustrated in Dr. Burmeister's Genera Insectorum, and in conjunction with Dr. Schaum in Germar's Zeitschrift.

The second tribe of the Lamellicorn beetles, Lucanides Latreille, has been monographed by Burmeister in the fifth volume of his Handbuch, in which it is divided into two families, Lucanidæ and Passalidæ ; the former divided into seven sub-families, Sinodendridæ, Æsalidæ, Syndesidæ, Chiasognathidæ, Lucanidæ genuini, Lamprimidæ, and Figulidæ ; and the latter consisting of the single genus Passalus. The Lucanides are separated by Burmeister into twenty-six genera.

A catalogue of the Lucanides, with descriptions of the new species in the splendid collection of Mr. Hope, has been published by that gentleman, in which a new plan of distribution of the species composing Burmeister's group Lucanidæ genuini has been proposed, and in which the whole of the species are retained under the old generic name of Lucanus. Many species of this family have also been described by Mr. Hope and myself in the Linnæan Transactions, and in the Transactions of the Entomological Society of London. Two remarkable genera from New Zealand, Mitophyllus and Dendroblax have been described by Parry and White. Two supplements to the monograph on the Passalidæ has also been published by M. Percheron.

The investigations of the HETEROMEROUS MELASOMATA (p. 530—532), has been continued by M. Solier in the Annals of the French Entomological Society, and in the Memoirs of the Royal Society of Turin. A number of valuable papers have also been published by Mr. Waterhouse in the Annals of Natural History, and descriptions of many species from South America, described by Mr. Curtis in the Linnæan Transactions.

The Blapsides have been reviewed by Fischer von Waldheim in the Bulletin of the Moscow Society.

The gigantic Tenebrionidæ of tropical Africa have been monographed by myself in the Transactions of the Zoological Society, and in the Arcana Entomologica, Vol. II., and the singular Australian Helæus, by the Marquis de Breme, in his series of monographs on the Heteromera, and by Mr Hope in the fifth volume of the Transactions of the Entomological Society. De Breme has also monographed the genera Misolampus and its allies, and Cossyphus. Many Russian, Persian, and Siberian species are described by various Russian Entomologists, in the Bulletin of the Moscow Society, and by Faldermann in his Fauna Transcaucasica. The Pedinites have been revised by Waterhouse in Annals of Nat. Hist., Vol. XVI.

The Stenelytra (p. 533), have also received considerable attention; the Œdemeridæ of Europe having been monographed by Schmidt in the Linnæa Entomologica, whilst the transformations of Helops ater, Melandrya serrata, Pyrochroa coccinea, Mordella fasciata, Œdemera seladonia, Boletophagus agaricola, and Diaperis Boleti have been observed by Dufour and Perris in the Annals of the French Entomol. Soc., and those of Orchesia micans by Brasellmann.

The Notoxides (p. 537), of Europe have also been monographed by Schmidt in the Entomol. Zeitung, others have also been described by the Marquis de la Ferté in the Annales of the French Ent. Soc., Vol. XI., and by Lucas in the Revue Zoologique.

The Mylabrides (p. 539), of Barbary have been described by Chevrolat, in Silbermann's Revue Entomol., Vol. V., and some beautiful Australian species of Helopidæ represented in my Arcana Entomologica. The transformations of the genus Meloe, have been investigated by Siebold in the Entomol. Zeitung; by Newport in the Transactions of the Linnæan Society; and by myself, in the Trans. of the Entomol. Society; and it is now ascertained that the Triungulinus or Pediculus Melittæ is the real larva in its youngest state. Its form, however, is very greatly altered before arriving at full size.

The great work of Schonherr upon the Weevils, RHYNCHOPHORA (p. 539), has been continued, and at length concluded (with the life of its author), in sixteen thick half volumes, and two supplemental Mantissæ. Of this work it will be impossible for us to give even the slightest abstract. In fact, from the circumstance that the latter volumes consist of a revision of the early ones, with great additions inserted into their places; and from the entire work being deficient in tabular synopses of the numerous genera, the investigations of this great tribe of Beetles is more intricate than ever. Great assistance is, however, to be obtained from the work of Labram and Imhoff, which contains coloured figures of one species of each genus, but as the work appears in numbers at wide intervals, and with numerous additional genera, it will be long before the Iconography of this family can be before us. Waterhouse has published various papers containing descriptions of exotic species, in the Annals of Natural History, the Proceedings of the Zoological Society, and the Transactions of the Entomological Society. Other exotic species are described by Chevrolat and Guérin in the Revue Entomologique. Many remarkable forms from New Zealand are described and figured by White in the Zoology of the Voyage of the Erebus and Terror. Many Australian species by Erichson in Wiegmann's Archives, and by Germar in the Linnæa Entomologica. Many valuable remarks on the North American species are published by Harris, in his work on the injurious insects of Massachusets; whilst the Curculionidæ of our own country have been revised by Mr. Walton in a valuable series of articles in the Annals of Natural History. About 7500 species are now known.

The Silesian species have been revised by Schilling, and the Russian ones by Gotsch in the Bulletin of the Moscow Society for 1847.

The Xylophagi (p. 542), have been studied to a great extent, and the greater portion of the genera (in fact the whole, with the exception of those forming the genus Scolytus in the text), have been removed from their position in this work and placed nearer to the Silphidæ and other clavicorn tribes, notwithstanding the numerical variation in the joints of their tarsi. Many of these groups have been revised by Dr. Erichson in his work on the Coleoptera of Germany, in which tables are added containing the characters of the exotic genera.

The natural history of Scolytus destructor, a species injurious to the elms, has been studied by Andouin, Spence, and others. The Paussidæ have been remonographed in my Arcana Entomologica, and the number of the species nearly doubled, with the addition of various new genera. A remarkable memoir on this genus is published by Burmeister in Guérin's Mag. de Zoologie, in which the Paussidæ are considered as most nearly allied to the Carabidæ; the species being now ascertained to crepitate like the Brachini, and to reside in ant's nests. The Bostrichi have been investigated by Guérin, Bull. Soc Ent. de France, Vol. III. p. 16, by whom ten genera are admitted into the group.

Several very remarkable genera have been lately added to the group, especially Acropis Burmeister, having the eyes placed on foot stalks, Langelandia Aubé, destitute of eyes; and Stemmoderus Spinola, having the thorax dilated into rounded tubercles cencealing the head.

Other singular forms are represented in my Cabinet of Oriental Entomology chiefly from India.

Some additions of great interest to the LONGICORNES (p. 544) have also been made. Here, approaching Spondylis (p. 545) must most probably be arranged the South American genus Hypocephalus, one of the most singular of known Coleoptera. It will, however, be necessary to establish a separate section for its reception, as is also required for that of Trictenotoma, an equally remarkable genus from the East, which I have also illustrated in the Cabinet of Oriental Entomology.

A valuable work upon the Longicornes of France has been published by M. Mulsant, who divides these insects as follows:—

Group 1. Procephalides (head slanting) divided into three families—Spondyliens, Prioniens, and Cerambycins.

Group 2. Clinocephalides (head vertical) divided into two families—Lamiens and Saperdins.

Group 3. Derecephalides (head fixed upon a distinct neck) divided into two families—Rhagieus and Lepturins.

Many new and beautiful exotic species of Longicorn beetles are figured and described by Blanchard in the Voyage

of D'Orbigny, by White in that of the Erebus and Terror, by myself in the Arcana Entomologica and Cabinet of Oriental Entomology (the former work containing a monograph of the New Zealand species and those of tropical Western Africa, allied to Sternotomis).

An illustrated monograph of Trachyderes and allied genera has been published by Dupont, in Guérin's Mag. de Zoologie, and a number of new exotic species has been described by Newman, White, Buquet, Reiche, Guérin, &c. and a memoir in the Australian Stenochoridæ by Mr. Hope, by whom also a number of splendid Indian species has been published in the Transaction of Linnæan Society. The Philippine Island species are described by Newman in the Entomologist. In all these works the number of genera has been greatly increased.

The EUPODA and CYCLICA (p. 549—553) under the general name of Phytophaga, proposed by Dumeril, form the subject of a work of great extent undertaken by M. Lacordaire, entitled a "Monographie des Coléoptères subpentamères de la famille des Phytophages," of which two volumes have appeared. In this very valuable work the phytophagous insects are divided into two primary groups :—

1st. The Apostasicerides, or those which have the antennæ wide apart at the base, containing the following tribes, each named after the typical genus—1. Sagrides, 2. Donacides, 3. Criocerides, 4. Megalopides, 5. Clythrides, 6. Cryptocephalides, 7. Eumolpides, 8. Chrysomelides.

2nd. The Metopocerides, or those who have the antennæ close together at the base, consisting of 9. Galerucides (including the greater part of the Halticides), 10. Hispides, 11. Cassidides.

The First Volume is occupied with descriptions of the species composing the first four tribes.

The Second Volume which is just published, is confined to the Clythrides, of which the author describes as many as 697, (nearly three times as many as are given in Dejean's Catalogue des Coléoptères.) The Clythrides are divided into five sub-families or tribes, namely :—

1. Clythridæ, containing only one genus Clythra with 255 species, but divided into forty sub-genera.
2. Babideæ, containing ninety-three species, divided into ten genera.
3. Megalostomideæ. containing sixty species, divided into five genera.
4. Lamprosomideæ, containing seventy-nine species, divided into three genera, and containing, as a species of Lamprosoma, the British Oomorphus Concolor, generally placed in the Byrrhidæ.
5. Chlamydeæ, containing 209 species, divided into seven genera.

This volume contains some very interesting observations on the cases formed by the larvæ of the different species, and composed of particles of their own excrement.

The careful revision of such of these tribes, as have been already published by M. Lacordaire, merits the highest praise, the genera having been rigorously examined, and the species minutely described. It may suffice, in order to show the extent of the materials in the hands of the author, to state that he has described as many as 273 species of the genus Lema in its present restricted state.

A great number of species of these tribes are described by Faldermann in his Fauna Transcaucasica. Some beautiful new forms are also described and figured by Mr. Hope in his Coleopterist's Manual. A memoir on the genera of exotic Cassidæ has also been published by Mr. Hope, in the Annals of Natural History, and many species of Hispa and the allied genera by Guérin (Revue Zool.), and Newman, (Entomologist.) A series of papers on the Australian species of Cryptocephalides has been published by Mr. Saunders in the Transactions of the Entomological Society. The European species of Lema and Cassida have been carefully monographed by Suffrian in the Entomol. Zeitung, and those of Cryptocephalus by the same author, in the Linnæa Entomologica. The transformations of various species have also been studied, namely, those of Clythra and Cryptocephalus, by Rosenhauer and Chevrolat; Colaspis ater by Joly, (Ann. Sci. Nat., Vol. II.); Cassida, by Gravenhorst and Scholtz, in Nova Acta; Hispa, by Dr. Harris; and Haltica, by Le Keux.

The relations of the Clavipalpi (p. 554), have been much discussed, and their affinity with the Engidæ among the Necrophagous Coleoptera, maintained by several authors. This is also the opinion adopted by M. Lacordaire in his very excellent "Monographie des Erotyliens," in which the Latreillian Erotylus, Triplax, and Tritoma are comprised. Languria is to be referred to the Engidæ, and Phalacrus and Agathidium form a family in the neighbourhood of the Silphidæ and Hydrophilidæ. These views, of course, materially interfere with the tarsal system, but they may be regarded as the exceptions to it, and not as proofs of its inaccuracy.

M. Lacordaire in his monograph, described 570 species of Erotyliens, being more than six times the number described by Duponchel in his monograph published only seventeen years previously. Of these 570 species, nine-tenths are natives of the New World. Only three species are described as natives of Asia; only two of New Holland; and sixteen of Africa. The family is divided by Lacordaire into two tribes—

1. The Engidiformes, with the inner lobe of the maxilla unarmed, or with one tooth, composed of fourteen genera, including Dacne, Triplax, Tritoma.
2. The Genuini, with the inner lobe of the maxilla armed with two teeth, including the genera Ægithus, Erotylus, &c.

The species are for the most part elegantly coloured and marked with spots of different colours, and they generally reside in boleti, agarics and other fungi.

A careful revision of the German Anisotomidæ has been made by Schmidt in Vol. III. of Germar's Zeitschrift, and by Erichson in his German Coleoptera. The minute genus Trichopteryx related to these insects, has also attracted great attention. See Heer in Entomol. Zeitung, 1843. Allibert in Guérin's Revue Zool., 1844. Schiodte in Kroyer's Naturh. Tiddskrift, 1845. Gillmeister in Sturm's German Fauna. Vol. XVII, and also Erichson's German Coleoptera. The transformations of Trichopteryx intermedia have been observed by Perris, (Annales Soc. Ent. France), and appear to prove that the genus is nearly allied to the Brachelytra.

The French species of the Fungicolæ (p. 554), have also been excellently monographed by M. Mulsant, by whom

three additional genera have been proposed, namely Polymus, Mycetina, and Golgia. Trochoideus Westw. is a very remarkable genus belonging to this tribe, having the antennæ terminated by a large, solid mass, like those of the genus Paussus, with which the typical species was at first arranged. Redtenbacher has also reviewed the European species in Germar's Zeitschrift, Vol. V. A curious little genus which has been referred to this family, has excited considerable attention on account of the singularity in the variation of the number of joints of the antennæ, it has received the names of Holoparamecus Curtis, (Calyptobium Villa). Its proper relations appear, however, to be toward the Necrophaga. See Guérin's Revue Zool., Westwood in Trans. Entomol. Soc., and Aube in the French Annales.

The family of the Ladybirds (Aphidiphaga, p. 555) has been also revised, so far as the French species are concerned, by M. Mulsant, in his work upon the Coleoptera of France; whilst M. Redtenbacher has also reviewed those of Germany, adopting for the Trimera the name of Coleoptera Pseudotrimera, proposed by me in the 'Introduction to the Modern Classification of Insects,' and dividing the Securipalpes or Aphidiphagi into two primary groups:—

1. Those with simple or bifid mandibles, divided into ten genera.
2. Those with multidentate mandibles, two genera.

Whilst M. Mulsant divides them into two primary groups, from the hairy or naked upper surface of the body, thus:—

1. Gymnosomides, with naked bodies, divided into three tribes, Coccinelliens (subdivided into sub-tribes and groups, and containing sixteen genera); Chilocoriens, with two genera; Hyperaspiens, with one genus.
2. Trichosomides, with hairy bodies, divided into three tribes; Epilachniens, with two genera; Scymniens, with four genera; and Cocciduliens, with one genus.

A number of Russian species of Ladybirds have been described by Faldermann and Motchoulsky.

A careful revision of the Pselaphi (which are now regarded by most writers, as most nearly allied to the Brachelytra, has been made by Aubé, in the French Annales for 1844; and Dr. Schaum has published a notice of the Synonymes of the British species, in the Zoologist for 1847. A remarkable Australian species with one-jointed antennæ, has been described by Hope, in the Trans. of the Entomol. Society of London.

THE ORDER ORTHOPTERA. (P. 556.)

In addition to the systematic works of Burmeister and Serville noticed in p. 557, we are indebted to M. De Haan for another general revision of the order in the great work published by the Dutch Government, illustrating the productions of the Dutch settlements in the Indian Archipelago. In this fine work the author has gone back to the Linnæan system of names, and instead of families, sub-families, &c., has consequently adopted the following primary divisions as *genera*:—Blatta, Mantis, Phasma, Acrydium, Locusta, and Gryllus, regarding all the genera of which each of these families (or genera) is composed, as sub-genera, and giving under each genus a list of the names adopted for these minor divisions, by Burmeister and Serville. The species are very carefully described, and many of them beautifully represented, some of the forms being very singular, and constituting new sub-genera. The Earwigs are regarded as a separate order. Another fine work on the Orthoptera of Russia has been published by the Count Fischer de Waldheim, in his Entomographie de la Russie, Tome IV, 1846, 4to., with thirty-seven plates. In this work the same general division is retained, each group being regarded as a family, and a considerable number of new genera and species described. Two papers by Charpentier, on the Synonymes of the species, in Germar's Zeitschrift, Vols. IV and V, must be referred to. Charpentier has also published a beautiful work entitled 'Orthoptera descripta et depicta,' containing figures of a great number of new and remarkable exotic species. Von Siebold has also published a treatise upon the Prussian species, forty in number, in Vol. XXVII of the Preuss. Provin. Blatt. A number of remarkable exotic species belonging to the different families are represented in my Arcana Entomologica, and Cabinet of Oriental Entomology, and descriptions of numerous North American species are given by Harris, in his work on the Injurious Insects of Massachusets.

THE ORDER HEMIPTERA—SECTION HETEROPTERA. (P. 563.)

The introduction of this order of suctorial insects between the masticating Orthoptera and Neuroptera, is at variance with the arrangements adopted by most recent Entomologists, who have considered the characters derived from the perfect state of the insect, to be of greater weight than the nature of its metamorphosis; the consideration of which led Latreille to place the Hemiptera in the situation which they hold in this work.

Several valuable works upon the classification of the Hemiptera have been recently published, the most important of which must now be concisely noticed. In the "Essai sur les gernes d'insectes, appartenants a l'ordre des Hémiptères, Linn.; on Rhyngotés Fab. et à la section des Hétéroptères, Dufour," by the Marquis Spinola, these insects are divided into five primary groups:—

1. Nepides. 2. Hydrocorizes, [Notonectidæ]. 3. Galgulites. 4. Amphibicoryzes, [Hydrometridæ], and 5. Geocoryzes, or the species residing on the ground, or on plants, and corresponding with the Linnæan genus Cimex; divided into ten families, namely, the Reduvites, Coreites, Phymatites, Aradites, Tingidites, Cimicites, Astemmites, Anisoscelites, Lygæites, and Pentatomites, each being named after its chief genus, and containing a considerable number of new genera and species.

In the "Histoire Naturelle des Insectes Hémipterès," by Messrs. Serville and Amyot, the tabulation of the groups and the generic division is carried to a mnch greater extent than in any preceding work. Thus the Heteropterous Hemiptera are divided into 355 genera, and the progression of the groups corresponds with that of Latreille in the text, being the reverse of that adopted by the Marquis Spinola. The first section, Geocorises,

containing eight families—1. Longiscutes, [Scutelleridæ and Pentatomidæ]. 2. Supericornes, [Coreidæ]. 3. Infericornes, [Lygæidæ and Anthocoridæ]. 4. Cecigenes, [Pyrrhocoris]. 5. Bicellules, [Capsidæ]. 6. Ductirostres, [Tingidæ, Cimex]. 7. Nudirostres, [Reduviidæ, Hydrometridæ, Salda, Acanthia]. And 8. Rameurs, [Gerridæ]. Whilst the second section, Hydrocorises, contains three families, typified by the three genera, Galgulus, Nepa, and Notonecta. Each of these families is subdivided to a great extent, and a number of new species described.

The principle of subdivision has been carried out to its utmost extent, in a more recent work upon the French species of the order by M. Amyot, with a view to the establishment of a new system of nomenclature in which every animal shall be known only by one name; thus doing away with the generic nomenclature, established by Linnæus. M. Amyot's work first appeared in the French Annales, and has subsequently been published separately. The Wanzenartigen Insecten of H. Schaffer has been continued, and a great number of new species represented in it. Vol. VII contains a revision of the Pentatomidæ. The publication of the descriptive catalogue of the Hemiptera in the collection of the Rev. F. W. Hope, has been continued, and many new genera added to the family Coreidæ. Schiodte has given a revision of the Fabrician species of Tetyra, in Kroyer's Danish Journal of Natural History; and A. White has described many new species of Scutelleridæ in the Transactions of the Entomological Society, and in Gray's Zoological Miscellany. Costa has published descriptions of numerous Italian and Sicilian species, whilst Kolenati has described a great number of Caucasian species in his Meletemata Entomologica, and Germar, many Cape of Good Hope species in Silbermann's Revue Entomol., Vol. V. An excellent monograph of the curious genus Opthalmicus, is contained in Fieber's Entomological monographs, as well as a complete illustrated monograph of the Tingidæ. A monograph of the Capsidæ has also been published by Meyen, accompanied by numerous plates. Monographs of the genera Phyllomorpha, Phymata, and allied genera, as well as descriptions of numerous singular new genera, have been published by myself, in the Arcana Entomologica, and Transactions of the Entomological Society.

Fieber has also monographed the genera Sigara and Ploa in his Entomologische Monographien.

THE SECTION HOMOPTERA. (P. 567.)

In the work of Messrs. Serville and Amyot, above noticed, the Homoptera are divided into two sections from the place of insertion of the rostrum or promuscis, Sect. I. The Auchenorhynches, in which the rostrum arises from the chin or middle of the under part of the head, divided into three families—1. The Chanteurs, (Cicada Linn., divided into twenty-one genera). 2. The Subtericornes, (Fulgora Linn., and the numerous genera separated therefrom), and 3, the Antericornes, (consisting of Membracis, Centrotus, and Cercopis, with the numerous genera separated therefrom); and Sect. II. The Sternorhynches, in which the rostrum appears to arise from the breast, divided into two families, corresponding with the Linnæan genera Aphis and Coccus. Thrips and its genera forms an appendix to the volume, being regarded as a distinct order under the name of Physopoda. Each of these families is subdivided into a number of sub-sections, down to the genera, which are very numerous.

Numerous new Swedish species of Homoptera are described by Bohemann, in the Swedish Transactions for 1845.

The Cicadidæ have been enriched with three fine genera, namely, Cystosoma, with the body like a large swollen bladder, and Tettigarca, both from New Holland, and Polyneura, with the fore wings thickly reticulated, from India. Many splendid additions have been made to the Fulgoridæ, by Mr. Hope, in the Transactions of the Linnæan Society, and by myself, in the Arcana Entomol., and Cabinet of Oriental Entomology, and the family Fulgoridæ has been entirely revised, and many new additional genera described by the Marquis Spinola, in the Annales of the French Entomol. Society. Mr. White has also described several beautiful species in the Annals of Natural History. Mr. Bowring, who has had the most abundant opportunities of observing the Chinese species Fulgora Candelaria, has never found it emit the slightest trace of luminosity.

The singular genus Derbe of Fabricius has been monographed by Boheman, in the Swedish Trans., and by myself in the Linnæan Transactions.

The very singular tribe of Membracides has been carefully studied by M. Leon Fairmaire in the Annals of the French Entomol. Society, and many new and curious species and genera described. Dr. Burmeister has also illustrated many of the genera, both of Fulgoridæ and Cercopidæ, in his Genera Insectorum, and Mr. White has described many large eastern species of the latter group.

The Aphidii have lately been revised by Kaltenbach and Hartig, in Germar's Zeitschrift; and in our own country by Mr. Walker in the Annals of Natural History and the Zoologist. In Kaltenbach's "Monographie der Pflanzenlause," Aachen, 1843, the one hundred and sixty-one species known to the author are arranged under twelve genera, divided into two chief sections—1st. the winged species, with the genera Aphis, Lachnus, Schizoneura, Vacuna, Pemphigus, Tetraneura, Chermes, and Phylloxera; 2nd. the wingless subterranean species, forming four genera, Rhizobius, Forda, Trama, and Paracletus. Many beautiful figures of these insects are given in Ratzeburg's Forst Insecten. A monograph of the curious genus, Monophlebus, is given in the Arcana Entomologica; Bouche has also described numerous species of Coccidæ in the Entomol. Zeitung for 1844.

THE ORDER NEUROPTERA (P. 574.)

The relations of the Neuroptera, as arranged in the "Animal Kingdom," have recently been much discussed, and several of the families of which it is here composed have been removed to the order Orthoptera, especially by some of the recent German Entomologists, whilst Brulle and Laporte have cut it up into several separate

orders. We must, however, here restrict ourselves to a notice of the chief works which have appeared on these different families.

The "Histoire Naturelle des Insectes Néuroptères," by M. Rambur, forming portion of Roret's "Suites à Buffon," appeared in 1842, and contains an entire monograph of the order, some portions of which, the Libellulidæ, Myrmeleonidæ, &c. have been very carefully investigated by the author (the Linnæan genus Libellula alone occupying nearly three hundred pages). In this work the author has nearly followed the arrangements of Pictet and Burmeister, retaining, however, the whole of the divisions as portions of the order Neuroptera. His seven divisions are as follows :—

1. The Corrodentia, containing the Termetidæ and Embiidæ.
2. The Psocidæ, including Psocus and Coniopteryx.
3. The Subulicornia, consisting of the Odonata [Libellula] and Agnatha [Ephemera].
4. The Planipennes, containing the Panorpidæ, Nemopteridæ, Myrmeleonidæ, Nymphidæ, Hemerobiidæ, and Mantispidæ.
5. The Semblides, containing Raphidia, Semblis, &c.
6. The Perlides.
7. The Trichoptères [Phryganea, Linn.]

Each of these divisions is subdivided into families and genera, and a great number of species described especially in the groups separated from Libellula, Linn. An excellent paper on the anatomy of some of the genera of this family is given by Loew in the third volume of the Linnæa Entomologica ; and the anatomy of many species is also illustrated in Dufour's Recherches Anatomiques et Physiologiques sur les Orthoptères, les Hyménoptères et les Néuroptères, 4to, 1841.

In addition to Rambur's work above noticed, the student must also consult the following works upon the Libellulidæ :—

Hagen Synonymia Libellularum Europæarum.

Charpentier Libellulinæ Europeæ, descriptæ ac depictæ, tabulis XLVIII.

Selys Longchamp Monographie des Libellulidées d'Europe, followed by numerous detached articles on the family in the Bulletin of the Brussels Academy, the French Annals, &c. The same author has also published a complete revision of the Synonyms of the British Species of Dragon Flies.

Boyer Fonscolombe, Monograph of the Agrionides in Annales Soc. Ent. France, Vol. VII.

Evans's British Libellulinæ, or Dragon Flies, illustrated in a series of lithographic drawings, 8vo, 1845, twenty-one plates.

The Ephemeridæ have formed the subject of a fine monograph by Professor Pictet, Geneva and Paris, 1843, 8vo with forty-seven plates. In this work the author adopts seven genera, Ephemera, Palingenia, Baetis, Potamanthus, Cloe, Cænis, and Oligoneura, founded not only on the characters of the perfect insect, but on those of the transformations of the species of which each is composed. An excellent memoir on the anatomy and transformation of Palingenia Virgo has been published by Cornelius.

The Perlides have been monographed by Newman, and by Pictet in his Histoire Naturelle generale et particuliere des Insectes Néuroptères ; famille des Perlides, Geneva, 1841, 8vo, fifty-three plates, in which work the author admits only six genera, Kollaria, Eusthenia, Pteronarcys, Perla, Capnia, and Nemoura The whole of these species are described and figured with great care. A remarkable peculiarity has been observed by Newport in a species of Pteronarcys, namely, the retention in the perfect state of the external branchiæ of the larva in addition to the ordinary series of spiracles of the Imago.

The Hemerobiidæ, of Belgium, have been monographed by Wesmael in the Bulletin of the Brussels Academy, and the British species have been illustrated by Evans in the Trans. of the Entomol. Society of London, Vol. V. A remarkable insect which inhabits the fresh water sponge has formed the subject of communications by myself, and by Professor Grube and Mr. Haliday, by whom it is regarded as the larva of Hemerobius fuscus.

A systematic distribution of the Ascalaphides has been published by A. Lefebvre in Guérin's Magasin de Zoologie ; a monograph on Nemoptera by myself in the proceedings of the Zoological Society ; Dr. Klug has also given a monograph on Panorpa and Nemoptera in the Berlin Transactions ; the Panorpidæ have also been revised by myself in the Transactions of the Entomol. Society of London. Dr. Erichson has published a monograph of the singular genus Mantispa, in his Entomographien ; and a monograph on Raphidia has also been published by Schneider.

In addition to the fine monograph of Pictet upon the Phryganeæ (Order Trichoptera Kirby ; family, Plicipennés, Latreille) noticed in our former supplementary notes, and the general works of Rambur, Burmeister, the first part of a work by Kolenati has recently appeared at Prague, entitled Genera et Species Trichopterorum, Pars prior, 4to, with three plates. This work promises to be of great service in the investigation of this difficult family. The first part comprises only the first family, Heteropalpoidea, containing the species having the maxillary palpi of the two sexes dissimilar, divided into three tribes—1. Limnophiloidea, divided into thirteen genera ; 2. Phryganeoidea, three genera ; 3. Sericostomoidea, twelve genera. The family Isopalpoidea, or those species having the maxillary palpi alike on both sexes will form the subject of a second part.

THE ORDER HYMENOPTERA. (P. 581.)

The Histoire Naturelle des Insectes Hymeneoptéres, commenced by Count Saint Fargeau (in which the system proposed by him of arranging the families according to their habits) has been completed in four thick volumes, 8vo. The first of these volumes contains the groups which live in societies which are either perennial

(ants and honey bees), or annual (humble bees and wasps). The second volume contains the solitary nest-making species (the majority of the genera of Apidæ and Andrenidæ), and the parasitic bees as well as the solitary wasps. The third volume (in which the author found it impossible to carry out his theory respecting the working or parasitic habits of the species as exhibited by the structure of the fore legs of the female) contains the various families of sand wasps, namely, the Crabronites, Bembecides, Sphegides, and Scoliides, including the Mutillidæ. The fourth volume is by M. Brullé, M. Saint Fargeau, owing to his great age (—he is since dead)—having renounced the authorship of the Terebrant Hymenoptera, and contains the families Chrysides, Ichneumonides, Braconides, Evaniides, Chalcidites, Proctotrupides, Cynipides, Oryssides, Urocerides, and Tenthredinides. In this volume the author has especially devoted his attention to the Ichneumonides and Braconides, in which families a great number of new genera and species, for the most part exotic, are described.

The Hymenoptera of Spain have been described by Erichson in Waltl's Travels; those of Algeria in Wagner's Travels, and many Australian species in Wiegmann's Archives; and a considerable number of Spanish, Egyptian, and Cayenne species by the Marquis Spinola, in the French Annalés. The Symbolæ Physicæ of Dr. Klug contains a considerable number of beautiful Egyptian species. Many of the Tenthredinidæ have been beautifully illustrated in Ratzeburg's Forst Insecten. Dr. Hartig's Blattwespen must also be studied. A remarkable collection of Cocoons, of a Brazilian species, has been figured by Mr. Curtis in the Transactions of the Linnæan Society, and the economy of several interesting species described by myself in the Gardener's Chronicle for 1847 and 1848.

Memoirs on the Evaniidæ by Mr. Shuckard, in the Zoologist, and by myself in the Trans. Entomol. Society must be referred to. The Belgian Ichneumonidæ have been investigated by Professor Wesmael in the Transactions of the Berlin Academy. The Ichneumonidæ have also formed the subject of one of the volumes of Ratzeburg's fine work on the Forst Insecten. An interesting paper on the Economy of the Ichneumonidæ, especially with reference to the species of insects upon which each subsists, is given by Boye in Kroyer's Natural History Tidsskrift, Vol. III. The genus Alysia has been revised by Mr. Haliday in his usual careful manner. The Cynipidæ have been studied by Hartig in Germar's Zeitschrift, and Dahlbom in his "Onychia and Collaspidia," and various new genera proposed. The Chalcididæ have been reviewed by Forster in his "Beitrage zur Monographie der Pteromalinen," Part I., and by Mr. Walker in "Monographs on the Chalcididæ," published in two volumes, and in detached articles in the various Natural History periodicals. Many of the species are beautifully figured in Ratzeburg's Forst Insecten, and outline figures of the British genera are given in the Entomologist, drawn by Mr. Haliday.

Many species of Chrysididæ have been described by Guérin, in the Revue Zoologique, and by Dr. Klug, in the Symbolæ Physicæ. A synopsis of this family is given by the latter in the Proceedings of the Berlin Academy.

The Linnæan genus Sphex, has been revised by Dahlbom in his excellent work entitled "Hymenoptera Europæa præcipue Borealia, &c., disposita atque descripta," in which the sand wasps are distributed into the ten following families.—1. Sphecidæ. 2. Ampulicidæ. 3. Pompilidæ. 4. Larridæ. 5. Nyssonidæ. 6. Bembecidæ. 7. Philanthidæ. 8. Mellinidæ. 9. Pemphredonidæ; and 10. Crabronidæ. A vast number of new species, and many new genera are described in this work. Some new genera allied to Chlorion are illustrated by me, in the Arcana Entomologica.

The Mutillidæ of New Holland are illustrated in my Arcana Entomologica, as well as the Dorylidæ, and a great number of new species of Thynnidæ. Monographs on the latter family have also been published by Dr Klug and M. Guérin. Mr. Shuckard also published a monograph on the Dorylidæ, in the Annals of Natural History. Observations on the habits of various species have also been published; by L. Dufour, on Cerceris bupresticida, Ann. Sciences Natur., XV; by Siebold, on Oxybelus uniglumis; and by Passerini, on Scolia, with a supplement detailing the interesting economy of the large Italian species.

A paper by myself, on some new genera of Ants, has appeared in the Annals of Natural History, and Mr. White has published some interesting observations on a Brazilian species of Wasp, which collects honey, in the same work. Mr. Curtis has also described some Wasps in the Trans. Linn. Soc.

A valuable series of papers containing descriptions of the *British species of Bees*, has been published by Mr. F. Smith, in the Zoologist, and one on the genus Hylæus, in the Transactions of the Entomological Society of London. The Natural History of Osmia, Ceratina, Stelis, and other Bees, has been given by L. Dufour, in the Annals of the French Entomol. Society. A paper on the economy of the Brazilian Meliponites, has been published by Spinola, in the Annalés des. Sci. Nat.

THE ORDER LEPIDOPTERA. (P. 603.)

The classification of this order has received much attention since the publication of our former edition. A discussion of considerable extent has been carried on between Messrs. Duponchel and Guenée as to the relative importance to be given to the characters of the insect in its preparatory states, or to those derived from the imago. M. Boisduval has adopted both these views to a certain extent in his several works. The distribution of the order into three primary divisions has been rejected by the last-named author, as well as the names Diurna, Crepuscularia, and Nocturna, by which they were known. In his "Histoire Naturelle des Insectes Lépidoptêres," he has employed for the first of these three groups the name of Rhopalocera, first proposed by Dumeril for the butterflies, and being unable to discover any real limits for the two other Latrellian groups, he has united them together under the name of Heterocera. from the varied structure of the antennæ. The same method is also adopted by Boisduval in his "Genera et Index Methodicus Europæorum Lepidopterorum," 8vo, 1840. In the former of these works he divides the butterflies as follows :—

Sect. 1. Succincti. Chrysalis attached by the tail and girt round the body, divided into six tribes—Papilionides, Pierides, Eumenides, Lycænides, Erycinides, and Peridromides.

Sect. 2. Suspensi. Chrysalis only suspended by the tail, divided into eight tribes—Danaides, Heliconides, Nymphalides, Brassolides, Morphides, Satyrides, Biblides, and Libythides.

Sect. 3. Involuti. Chrysalis enclosed in a Cocoon, consisting of only one tribe, Hesperides.

The Heterocera are divided in the latter work into the following tribes—Sesiariæ, Sphingides, Zygænides, Lithosides, Chelonides, Liparides, Bombycini, Saturnides, Endromides, Zeuzerides, Psychides, Cocliopodes, Drepanulides, Notodontides, Noctuæ, divided into Noctuo-Bombycini, Bombycoides, Amphipyrides, Noctuides, Hadenides, Leucanides, Caradrinides, Orthosides, Xylinides, Calpides, Plusides, Heleothides, Acontides, Catocalides, and Noctuo-phalænides. Geometræ (not divided into tribes). The Micro-Lepidoptera are not contained in this work of Boisduval.

Other general works upon the order are—

Freyer's Neue Beitrage zur Schmetterlingskunde, in numbers.

Fischer Edler von Rosslerstamm's Abbildungen zur Berichtigung and Erganzung der Schmetterlingskunde, in numbers.

Ratzeburg's Forst Insecten, Vol. II., and in the Nova Acta, Vol. XIX.

British Butterflies and their Transformations, one vol. 4to, and British Moths and their Transformations, two vols. 4to, by J. O. Westwood, with plates drawn by Humphries.

H. Doubleday's List of British Lepidoptera, October, 1847.

Eversmann, in the Bulletin of the Moscow Society, and Fauna Lepidopterologica Volgo-Uralensis, a valuable work which has almost entirely been destroyed by fire.

Herrich Schaffer's Systematische Bearbeitung der Schmetterlinge von Europa.

Duponchel Catalogue Methodique des Lépidoptères d'Europe, Paris, 1845.

Guenée Europæorum Microlepidopterorum, Index Methodicus, Paris, 1845.

Selys Longchamps Enumeration des Insectes Lépidoptères de la Belgique.

A valuable memoir by M. Lefebvre, on the arrangement of the veins of the wings in this order, has been published in the Annals of the French Entomological Society. A paper on the same subject has also been published by Mr. E. Doubleday in the Transactions of the Linnæan Society of London.

Many interesting exotic species have been described by White in Gray's Travels in New South Wales, and by Doubleday in Dieffenbach's Travels. Kollar has described many species in Hugel's Travels in Cashmere and the Himalayas. Others from Egypt are figured by Klug in the Symbolæ Physicæ. A beautiful work on the Lepidoptera of North America was commenced by Boisduval, but it extended only to the butterflies. A number of interesting exotic species have also been figured in the volumes of Lepidoptera in Jardine's Naturalist's Library.

A magnificent work on the genera of butterflies has been commenced by E. Doubleday, of which twenty-two numbers have appeared. It contains a complete list of the species of each genus, with figures of one or more types in each. The species of Papilio inhabiting the Dutch Settlements in the East, have been described by De Haan in the great national work on the Eastern possessions of Holland.

A great number of new species, chiefly belonging to the genus Papilio, have been figured in my Arcana Entomologica and Cabinet of Oriental Entomology. Mr. Edward Doubleday has also published descriptions of a great number of new species of butterflies in the Annals of Natural History. A remarkable and extremely beautiful genus from India has been first described and figured by Mr. Hope under the name of Teinopalpus, which merits notice, as its situation in the system is at the head of the order.

A memoir by Herrick Schaffer, on the distribution of the Satyridæ, is also deserving of notice.

Some singular North American Bombycidæ have been described by E. Doubleday in the Entomologist. The same author has described a number of beautiful species of Gymnautocera in the Annals of Nat. Hist. Many fine species of Saturnia are figured in the Cabinet of Oriental Entomology.

The classification of the Noctuidæ has been undertaken by Guenée in the Annals of the French Entomological Society, and a list of the British species has been published by H. Doubleday in the Zoologist. The Micro Lepidoptera have recently been carefully studied; and numerous papers by Zeller in the Linnæa Entomologica, Entomologisches Zeitung, and Isis, and by Mr. Stainton and others in the late numbers of the Zoologist are to be noticed. The Pterophoridæ have also been revised by Zeller in the Isis, 1841.

THE ORDER RHIPIPTERA. (P. 614.)

The natural history of these very singular insects has been studied by Westwood (Trans. Ent. Soc.), Von Siebold (Wiegmann's Arch.), and Newport (Trans. Linn. Soc.), and the supposed larvæ with the head protruded between the rings of the abdomen of the bees and wasps, are now proved to be the females which produce living young from their heads. A paper by Mr. Thwaites and one by Dr. Templeton on a Brazilian species, have been published in the Transactions of the Entomological Society, and Mr. Newman has commenced a memoir on the order with a view to the determination of its situation in the system, in which he has overlooked the real nature of the transformations of the male insect, and has consequently erred in the situation assigned to the order.

THE ORDER DIPTERA. (P. 615.)

The completion of M. Macquart's work on Exotic Diptera, and the publication of a valuable work by Zetterstedt in seven volumes, 8vo, on the Diptera of Scandinavia, are especially to be mentioned, as well as the Insecta

Lapponica of the latter author. The classification proposed in the "Diptera Scandinaviæ" (which is a modification of that in the Insecta Lapponica, is as follows :—

Class I. Brachycera. Antennæ, two- (or three-) jointed ; Palpi, two- (or three-) jointed.

Order 1, Polychoeta. Haustellum, with four or six lancets, &c.

Section 1. Antennæ with the third joint annulated, without any apical style. This section comprises the families—1. Tabanii. 2. Xylophagii. And 3. Stratiomydæ.

Section 2. Antennæ with the third joint not annulated (generally without a dorsal seta). Families—4. Asilici ; 5. Bombyliarii ; 6. Anthracides ; 7. Leptides ; 8. Acrocerinæ ; 9. Hybotidæ ; 10. Tachydromides ; 11. Empidiæ ; 12. Dolichopodes ; 13. Syrphici (this family having a dorsal seta to the antennæ).

Order 2. Dichoeta. Haustellum with only two lancets.

Section I. Athericera. Haustellum with a proboscis, claws simple.

Subdivision 1. Wings with a distinct angulated cell. Families—14. Scenopinii ; 15. Platypezinæ ; 16. Conopsariæ ; 17. Myopariæ ; 18. Pipunculini.

Subdivision 2. Wings without a distinct angulated cell. Families—19. Oestrides ; and nineteen other families separated from the genus Musca of this work (p. 632—636).

Section 2. Haustellum, covered by two palpi, but without a terminal proboscis. Family—39. Coriaceæ [Hippoboscidæ.]

Class II. Nemocera. Antennæ, with not fewer than six joints.

A. Winged. Families—40. Hirteides ; 41. Scatopsides ; 42. Simulides ; 43. Rhyphii ; 44. Culicides ; 45. Chironomii ; 46. Cecidomyzides ; 47. Psychodides ; 48. Sciarinæ ; 49. Tipulides ; 50. Mycetophilinæ.

B. Wingless in both sexes. Family—51. Chioneides.

The genera and species are admirably worked out in these works by Zetterstedt, which are a model for the monographer.

Other general works on the Diptera are the following :—Loew's Bemerkungen über die in der Posener Gegend, Zweiflugler—Gattungen, and Dipterologische Beitrage, in 4to., and various papers in the Linnæa Entomologica, and Entomologische Zeitung, of the Stettin Society ; Zeller's Beitrag zur Kenntniss der Dipteren, and Dipterologische Beitrage. Staeger, on Danish Diptera, in Kroyer's Natural History Journal, and on the Diptera of Greenland, in ditto. Gimmerthal, Ubersicht der Zweiflugler Lief, and Kurland's (Bulletin Moscow Soc.), and on Russian Diptera, also in Bulletin Moscow, 1845. Rondani Memorie per servire alla Ditterologia Italiana, (nine separate memoirs in the Transactions of the Bologna Academy).

Various anatomical memoirs by Loew and Leon Dufour have also been published.

Of detached monographs on the families or genera of this order, the following are the most important :—

In the Nemocera (p. 617—621) ;

The genus Anopheles (p. 618), is monographed by Loew, in the first part of his Dipterologische Beitrage, and three new genera established, allied to Cecidomyia. The genera Scatopse and Bibio are treated in like manner by the same author, in the First Volume of the Linnæa Entomologica.

Two admirable papers by Dr. Asa Fitch, on the Wheat and Hessian flies belonging to the genus Cecidomyia, have been published in the Transactions of the New York State Agricultural Society, Vols. V and VI. The economy of other species of Cecidomyia have been illustrated by Perris and L. Dufour, in the French Annales ; and by Ratzeburg, in his Forst Insecten. Perris has also given the Transformations of Psychoda nervosa, in the same Annales. An excellent monograph on the Asilidæ is given by Loew, in Vol. III of the Linnæa Entomologica, in which a great number of new species and several new genera are proposed. Various new genera of Bombyliidæ are also described by the same author, in the above-mentioned works. An illustrated monograph of the fine family Mydasidæ, is given in my Arcana Entomologica, and the singular family Vesiculosa, or bladder-flies, have been monographed by Erichson, in his Entomographien ; and many additional species described by myself, in the Transactions of the Entomological Society. The Dolichopodes, monographed by Mr. Haliday, in the Zoological Journal, have been again revised by Staeger, in Kroyer's Journal.

The genera Oxycera, Thereva, and Conops, are also monographed by Loew, in his Dipterologische Beitrage, as well as several genera of Muscidæ. The Italian species of Merodon and Chrysotoxum, have been described by Rondani, and a monograph of the genus Ceria, published by Saunders, in the Transactions of the Entomological Society.

The parasitic Œstridæ have formed the subjects of several valuable memoirs, namely—a paper on the anatomy of Gastrus Equi, by Van der Kolk ; a memoir by Dr. Schwab, Die Œstraciden Bremsen der Pferde, Rinder und Schafe, Munich, 1840. A supplementary paper by Bracy Clark, in Vol. XIX of the Linnæan Transactious, and a paper by Goudot, on Cuterebra noxialis, in the French Annales. A fine monograph has also been published in the Annals of the Lyons Academy.

The great family Muscidæ, has been specially investigated by Robineau Desvoidy and Macquart, in the French Annals, between whom a discussion on the principles of classification of the family has taken place, the latter author having reduced many of the species proposed by the former, to varieties of other established species. Many detached genera have been monographed by Loew ; and the splendid genus Rutilia, by Guérin, as well as the interesting Ceratites, the type of which commits so much damage to the cargoes of oranges. The Ephydrini have also been revised by Stenhammer, in the Transactions of the Stockholm Academy, and many Danish groups have been monographed by Staeger, in Kroyer's Journal. The beautiful genus Trypeta, has been monographed by Walker, in the Entomological Journal, and by Loew, in the Linnæa Entomologica ; and a valuable memoir on the anatomy of the Hippoboscidæ, has been published by Leon Dufour, in the Annales des Sciences Naturelles.

FOURTH GREAT DIVISION OF THE ANIMAL KINGDOM.

THE RADIATA (Radiated Animals, or Zoophytes).

[Neither of these names is literally applicable, for all the animals in the division are not radiated; and the very name Zoophyte, "plant-animal," is a contradiction. In England, the term Zoophyte is much more restricted than in France, but it is equally inapplicable, excepting, perhaps, to those species, about which there are still disputes as to whether they are animals or vegetables.]

These animals have no mesial plane, but may be variously divided into symmetrical parts, radiating from one or more axes. Their organs of motion, when they have any, are moveable spines attached to the skin, or flexible papillæ, capable of inflation. They have no true system of circulation, and their nervous system is always obscure, and sometimes cannot be traced. Some have a mouth and vent, others only one opening, and others, again, appear to be nourished through pores. Some are of distinct sexes; some bisexual, and some are produced by buds or division. [Some very minute ones, as *Volvox*, consist of a globular tunic inclosing a vast number of smaller globes, each of which is also a tunic inclosing another generation.] Many grow in clusters upon stalks, or Polypidoms—dwellings of polypi, which are sometimes leathery or horny, and sometimes calcareous. [The individuals produce the polypidoms, and are connected with it; and when they are alive, it is probably always covered with an epidermis.] According as their organization is more or less complicated, they are divided into five classes:—

1. Echinodermata [Spiny Skins], have, besides these, the intestine and organs of respiration, reproduction, and partial circulation, floating in a large cavity. The *Holothuriæ* are united to them; because, although they have no spines on the skin, the internal structure is even more complicated.

2. Entozoa [Intestinal Worms], inhabit the viscera of other animals. They are long and flattened; have no visible organs of circulation or respiration; and some have a distinct alimentary canal, while others have not. [A species which infests the intestines of the Eel was, for a long time, regarded as the young of that animal.]

3. Acalepha [Sea Nettles], are round and radiated, with only one opening to the body, and no organs of respiration or circulation. They approach the Polypi, only their organic tissues are more developed.

4. Polypi [Many Tentacula, once considered as plants]. These are gelatinous animals, with a mouth and digestive organs more or less complicated. Many of them live in clusters upon branched or expanded polypidoms, which made them be considered as animal plants. [Individually they are minute, and some of them microscopic; but still they fabricate vast reefs of hard rock, consisting of salts of lime cemented by animal

matter. The *Thethyæ* and *Sponges* have been joined to this class, though their animals have not yet been observed.

5. INFUSORIA [Animalculæ], the most minute members of the Animal Kingdom, and for the most part microscopic. Some have a very complicated organization, and some appear to be mere particles of animated jelly. [They exist in countless myriads principally in stagnant water, and some are so tenacious of life, that, after having been for some time dried to powder, they revive again when moistened.]

THE FIRST CLASS OF THE RADIATA.

THE ECHINODERMATA.

These have a well-organised skin; sometimes a sort of skeleton; a digestive and a vascular system; and a sort of radiating nerves. There are two orders: those with feet, or vesicular appendages answering the same purpose, and those without.

THE FIRST ORDER OF THE ECHINODERMATA.

PEDICELLATA.

These have the skin pierced with numerous small holes, through which protrude cylindric tentacula, terminating in suckers. These are extended or retracted by a humour distinct from that of the intestines, discernible in some of the species, and answer the purpose of feet, by which they perform their locomotion, or adhere to the rocks. Vessels from these continue to unite in a trunk for each row, which trunk terminates near the mouth. The order consists of three very natural families.

THE FIRST FAMILY OF THE PEDICELLATA,—

THE ASTERIAS [Star-fish],—

So called, because the body is generally in the form of a star with five rays. Some, however, as *A. discoidea*, have the body a pentagon, with straight sides; others, as *A. membranacea*, have a re-entering angle in each side; and others, again, as *A. tesselata*, have the sides concave.

The frame-work of the body is composed of horny pieces, variously arranged. In those which have distinct rays, there is a longitudinal groove in the upper surface of each ray, perforated on both sides, for allowing the action of the feet; and all the surface is covered with pores leading to small tubes which admit water, probably for the purpose of respiration. On the central disc, but toward one side of it, there is a stony plate, and below it a canal filled with calcareous matter; and it is probable that this is the apparatus by which the hard matter of the body is elaborated. There is a sort of vertebrated osseous column in each ray; and some of the species have osseous plates, and spines on the sides of the rays. Internally, they have one stomach, with two branched cœca extending to each ray; each ray, also, contains two ovaries, and it is understood that they propagate by self-impregnation. The rays are easily reproduced, for the central disc and one ray will reproduce all the others. The mouth, which is the only opening to the alimentary organs, is on the under side of the central disc. According to Tiedemann, the principal nerve surrounds the mouth, and sends off a filament to each arm. Such are

Fig. 138.—Asterias.

the general characters of the genus Asterias, the Star-fish, properly so called; and, in proportion as they deviate from the Five-rayed Star, their cœca and ovaries are more numerous.

A. rubens, is very common in the European seas. *A. glacialis*, is much larger, often a foot in diameter; and it has tufts of fleshy tubes round the bases of the spines on the body. *A. aurantia*, is still larger, and has the edges of the rays paved with osseous plates, bearing strong and moveable spines. Some, as *A. paposa*, have more than five rays. Some have the rays solid, and without the groove, and they are called *Ophiuræ*, because their rays have some resemblance to the tails of Serpents. These move by flexures of the rays, which have spines on the sides in some, and are covered with imbricated scales in others. In them the pores are between the bases of the rays. The only feet which these have are in fine short grooves round the mouth. By some authors they have been made a separate genus. Some have the rays branched, and of them some have the division near the end of the rays, and seldom repeated; but in others it begins at the base, and each division is branched again and again, till the whole resembles a bunch of Serpents' tails; each branching is into so many lateral parts: there are two points at the base of each ray. Those branched ones have been called *Gorgonocephalæ*, or Medusa's Heads.

Alecto, or *Comatula*, have five large articulated rays proceeding from a stony plate on the upper part of the disc; their rays are often divided into two or three branches, and both rays and disc are furnished with articulated threads. The cavity of the body has a star-shaped mouth, and a tubular opening, both on the under side.

ENCRINUS [the Encrinites],—

Resemble the last, but have the plate on the disc prolonged to a stem of many articulations. They are named from the form of the stem, and the number of rays. *Pentacrinus europæus*, is the only species in the European seas; but there are others in the tropical oceans. In a fossil state they are exceedingly numerous, and varied in their appearance. The fossil Entrochites are portions of the stems or branches of Encrinites.

THE SECOND FAMILY OF THE PEDICELLATA.

THE ECHINUS [Sea Hedge-hogs, or Sea Eggs].

These have the body covered with a crust of calcareous matter, in segments nicely adapted to each other, and perforated by regular rows of holes for the membranous feet. The crust is also pierced by a number of smaller holes with four membranous tubes, which seem to be the breathing apparatus; and where not perforated, the crust is armed with broad spines, articulated upon tubercles, and moveable. The mouth is furnished with five flat, calcareous teeth, in a very complicated apparatus, and having strong muscles; and, as these wear away at their cutting edges, they extend by growth at the opposite extremity. The intestine is long, and attached spirally to the interior of the crust. The five ovaries, which are edible, are arranged round the vent, in the separate openings. Their motions are slow; and they feed upon the smaller shelled Mollusca and Crustacea, which they seize with their membranous feet. Great numbers of them, including many not now found alive, are met with in a fossil state, especially in the chalk, where they are usually filled with flint earth, the same as the sponges.

They are either regular or irregular,—the regular ones having the mouth in the middle of the under side, and the vent opposite; and the others are irregular in proportion as they deviate from this character.

Echinus, properly so called.—Figure generally an oblate spheroid, with two bands of apertures, dividing the surface from the mouth to the vent into segments, resembling those formed by the meridians on a globe. Some have the spines stout, with smaller ones at the base, and others have them slender. Among the latter, is *E. esculentus*, found in the European seas. It is about the size of an ordinary apple, closely set with short spines, generally of a violet colour. The ovaries are of the same colour; and in the spring months they are edible, and have a very agreeable flavour.

They vary in shape, and in the number and arrangement, and also the form of the spines. Some are depressed, some compressed, some have the spines unequal, and one species, *E. atratus*, has the spines unequal and truncated, resembling small paving-stones.

None of the irregular ones have the two apertures of the body opposite to each other in the middle of the under and upper sides. The spines upon them are straight and slender; and the chief distinctions are the number, arrangement, and extent of the holes for the feet.

Chironeus, have the general form of the last, but the mouth and vent are both on the under side.

Nucleolites, have the vent above, but near the margin.

Galerites, have a flat base, and a conoidal body, with the mantle in the centre of the disc, and the vent near its margin.

Scutella, have the openings as in the last, but the form of the body much depressed, and disc-like. Some have no openings to the crust but the pores, and in others again these seem to be obliterated, or at all events do not

penetrate into the cavity. *Rotula* has one of the margins toothed like a wheel; and some have large pores, and some not.

Cassidulus, are oval, with the vent above the margin on one side, and the lines of pores incomplete. They are distinguished by the number and extent of the lines of pores, which in some species form only a rosette on the back.

Clypeaster, have the vent near the margin, the body depressed, the base concave, and the outline sometimes angular and sometimes round.

Fibularia, small in size, mostly globular, with the openings on the under side, and a rosette of pores above.

Spatangus, have the openings below, and the rosette on the back. Some have the outline round or oval, and sometimes with a deep groove on one side, making the section heart-shaped.

Of the last, two specimens are found in the European seas; and the last, especially, has branched tentacula surrounding the mouth, in which character it bears some resemblance to *Holothuria*. The other irregular ones are chiefly fossil, and abound in various marine strata, especially in the chalk formation.

THE THIRD FAMILY OF THE PEDICELLATA.

THE HOLOTHURIA (Sea-slug).

These have the body oblong, with a leather-like covering, and an aperture at each end. The mouth is without teeth, or has only bony plates instead; but it is surrounded by curiously-branched tentacula, which the animal can, at pleasure, retract entirely; and it is also furnished with sacs for the secretion of saliva. The reproductive organs are also situated near the mouth, composed of a number of ramified culs-de-sac, all opening into one oviduct. The impregnating parts are understood to be some very elastic chords near the other extremity of the animal; thus each individual is bisexual. The intestine is long, convoluted, and fixed to the covering of the body by a kind of mesentery. Along the intestine there is also a double system of complicated vessels, which appear to be the organs of circulation. The opposite extremity is not less curious; for, besides the vent, it contains the respiratory organ, or gill, which is in the shape of a hollow tree very much branched, and the animal can receive or expel water by means of this apparatus, which possibly thus assists it in its locomotion, as well as supplies air from the inhaled water. In the breeding season the ovaries become very much extended, and contain a reddish matter, which is understood to be the spawn, or eggs. These animals are exceedingly sensitive, as is the case with the Leeches among *Annelidæ;* and when disturbed, they sometimes contract so violently that the integuments are ruptured, and the intestines protrude. The subdivisions are made according to the arrangement of the feet.

Thus, in some, as in *H. phantapus*, which inhabits the European seas, and has the body almost scaly, all the feet are on a soft disc in the middle of the body; and when they crawl, the extremities are turned up. When extended, the tentacula of these are very large.

Some, as *H. squamata*, a small species of the European seas,—but there are much larger ones in hot climates,—have all the under surface soft, with numerous feet; and the upper surface convex, sometimes supported by bony plates, and the opening of the mouth in the form of a star.

In others, again, the body is cartilaginous, flattened horizontally, and sharp at the edges, with the mouth and feet on the inferior surface. Of these, *H. regalis*, found in the Mediterranean, is more than a foot long, three or four inches broad, and crenulated at the edges.

Others still, have the body cylindrical, and capable of being inflated with water. All the under side is furnished with feet, and the remaining parts roughened in various ways. *H. tremula*, common in the European seas, the Mediterranean especially, is an instance of this peculiarity of form. It is of a black colour; more than a foot long when inflated with water; has the back bristled with soft conical points, and the mouth furnished with twenty branched tentacula.

Yet, in others, the feet are arranged in five rows, like the ridges on a melon, of which the European species, *H. penacta*, is more than a foot long, and of a brown colour.

There are also some, as *H. papillosa*, which have the body equally furnished with feet round its whole surface.

[The *Holothuriæ* of the European seas, even of the Mediterranean, are not very numerous, neither are they brilliant in colours; but in more tropical seas, where coral reefs rise within a moderate distance of the surface, as in the Red Sea, and the seas to the north and east of Australia, they are exceedingly numerous, and many of them splendidly coloured; so that, together with other Radiata of this and of other orders, they make the sea-bottom, when seen by the light of an almost vertical sun, as gay as a tropical garden. The Holothuriæ resemble cucumbers; and various Actiniæ, when their tentacula are expanded, have as gay an appearance as the flowers of almost any plants. Many of this species are esculent, and of a very gelatinous nature. When properly prepared, the Chinese are exceedingly fond

of them as a principal ingredient in restorative soups. The Malays catch and dry them in great quantities for the Chinese markets, where they fetch a high price, and are called *tre-pang*.]

THE SECOND ORDER OF THE ECHINODERMATA.

APODA.

The number of known species in this order is but few. They resemble Holothuriæ, but want the feet; and their leather-like skin is quite unarmed.

MOLPADIA,—

Have the form of the body and the internal structure similar to those of Holothuria, but they have no feet or tentacula, and the bony parts of the mouth are less complicated than in the Echini.

M. holothurioides, of the Atlantic ocean, was the only species known to Cuvier.

MINYAS,—

Have the body without feet, but of a spheroidal form, and furrowed like a melon.

M. cyanea, is a beautiful species, of a dark blue colour, inhabiting the warmer parts of the Atlantic; the mouth in this genus has neither tentacula nor bony plates.

PRIAPULUS,—

Have the body cylindrical, with deep annular rugæ, and terminated anteriorly by an elliptical and longitudinally wrinkled mass, in the centre of which is the mouth, with numerous teeth arranged in quincunx, and having the points turned backwards. The muscular system resembles that of Holothuria.

P. vulgaris, the only known species, inhabits the northern seas, and is from two to three inches in length.

LITHODERMIS,—

Have the body oval, compressed in the hinder part, and covered above with an extremely hard granulated crust; the mouth has tentacula, but Cuvier discovered no second opening to the body.

Only one species, *L. cuneus*, from the Indian seas, about two inches long, and of a blackish colour, was known to Cuvier.

SIPHUNCULUS,—

Have the body long and cylindrical, and wrinkled both longitudinally and across; the mouth is an extensile and retractile proboscis; the intestine straight for nearly the whole length of the body, and then returning in a spiral upon itself. In these, and indeed in most of the order, there are threads which appear to be nerves, and in this genus the breathing apparatus are on the sides, and open near the vent.

Fig. 139.—Siphunculus.

There are a good many species, most of which live in the sand, though some small ones perforate submarine rocks, and lodge in the cavities. *S. edulis*, which is eaten by the Chinese in the Oriental islands, occurs also in the salt lakes of Languedoc. They are used by the fishermen as bait. Some Indian species are nearly two feet long. They used to be classed with worms, but their organization is quite different.

BONELLIA,—

Have the body oval; the proboscis very extensile, and forked at the extremity: their intestinal canal is long and convoluted. What appear to be the organs of respiration are situated near the vent; and the ovary is an oblong sac which opens near the base of the proboscis. They inhabit the sand at a considerable depth, and can elevate their proboscis to the water, or even to the air, where the water is very shallow.

B. viridis, of a green colour, and is found in the Mediterranean.

THALASSEMA,—

Have the body oval or oblong, and the proboscis in the form of laminæ, resembling the bowl of a spoon, but not forked. The intestinal canal resembles that of the preceding genus, but they have only one abdominal thread.

They are distinguished into Thalassema proper, which have two lateral hooks placed considerably in advance,

and no thread-like appendages at the posterior extremity, of which *T. Neptuni* is an example; and *Echiurus*, which have bristly hairs at the posterior extremity. They inhabit the sands, and are much sought after by fishermen as bait. *Sternaspis*, has bristles as in the last, and a disc of a horny texture, and surrounded with hairs on the anterior part of the body. The habits of all these are very much the same.

THE SECOND CLASS OF THE RADIAT

THE ENTOZOA, OR INTESTINAL WORMS.

This class is remarkable for by far the greater number being inhabitants of the internal parts of other animals, in which alone they can continue their species,—so that it must be regarded as their natural habitat; and they must have a use in the economy of nature with which we are quite unacquainted. There is scarcely one animal, especially of the vertebrated classes, which is not infested by several kinds; and those which inhabit one animal, are rarely found in one of another genus. They are met with most abundantly in the alimentary canal, and the ducts which empty their contents into it; but they occur also in the cellular tissue, and in the parenchyma of the most closely invested viscera, such as the liver and the brain. They are most frequent in diseased states of the viscera, and they themselves occasion disease, or, at all events, annoyance; but they occur even in healthy states. The difficulty of conceiving how they could get into places so obscure, and apparently so well protected, and the fact of their never having been found alive except in the interior of living animals, caused it for a long time to be believed that they were products of spontaneous generation. It has been found, however, by actual observation, that most of them either produce ova or living young ones, and that many of them have the sexes in different individuals. Though some of them attain a very large size, we must suppose that the germs are exceedingly minute, and capable of being transmitted through capillary vessels, and apertures too small for being discerned by the naked eye; and, from the early age at which they are found in some animals, there is reason to conclude that the germs have been in these anterior to their birth, [though how transmitted through the placental decidua is, and probably must remain, an unexplained and unexplainable mystery. As is the case with all mysteries, the Intestinal Worms, more especially those which inhabit the human viscera, have led to a great deal of mystification and quackery, and nostrums innumerable are recommended to the public; nor are there wanting fabricated imitations of some of the more formidable species, usually prepared from the intestines of other animals.]

The *Entozoa* are true parasites, and cannot assimilate matter for their own growth and nourishment unless they receive it from the body of a living animal. They have no vestige of breathing apparatus, which shows that they must receive their nourishment aerated by the breathing of the animals upon which they are parasitic. This supersedes all necessity of a circulating system; and the traces of a nervous one are so very obscure that many naturalists have doubted its existence. When we find the character and the form of these animals in any species, we include it along with those which it most resembles, though it should not be parasitical within the body of any other animal. The injury which these Intestinal Worms occasion to the animals

upon which they live, when their numbers become excessive, are well known ; and we may mention, that the best remedy for those infesting the human intestines, appears to be animal oil mixed with spirits of turpentine.

The class admits of division into two orders, of which the organization is so different that they might, perhaps, be considered as two distinct classes ; or, at all events, subclasses. These are,—ENTOZOA NEMATOIDEA, or Cavitied Entozoa, which have the intestine floating in a distinct abdominal cavity, and commencing at a mouth and terminating at a vent ; and ENTOZOA PARENCHYMATA, which have the viscera obscure, generally in the form of vascular ramifications, and sometimes not at all discernible.

THE FIRST ORDER OF THE ENTOZOA.

NEMATOIDEA.

The members of this order have an external skin, more or less provided with muscular fibres, and striated transversely. They have an intestinal canal running distinctly through the whole length, and attached to the skin or tunic of the body by many filaments, which appear to transmit nourishment. There is no circulation ; but, in some species, there are two cords extending from a ring round the mouth, which are understood to be nerves. Reproductive organs are apparent in all, and in some they are greatly developed ; nor is the reproductive energy of the animals under circumstances favourable to its developement less active than the organs would indicate. This order forms only one family, but contains several genera.

Fig. 140.—Pentastoma tænoides.

FILARIA (Thread-worm),—

Has the body long, slender, and thread-like, resembling that of the *Gordii* among Annelidæ, but with mere marks on the body instead of the rings. The mouth is a circular opening at the anterior extremity. They are not found in the open cavities, but are imbedded in the parenchyma of the cellular tissues, between the coats of the viscera, and in other situations: they often exist in numerous bundles, contained in a common cyst or tunic. They are not confined to the larger animals, but are found in insects and their larvæ, and even in various Mollusca.

The most common, or at all events the most dreaded by Man, is the Guinea Worm, *F. Medinensis*. This troublesome animal is very common in hot climates, where it insinuates itself under the skin, generally of the leg, and is said to gnaw to the length of ten feet, or more. According to the accounts it will, if undisturbed, remain in the body for a long time without causing much uneasiness; but, if it is disturbed, it is said to cause the most excruciating pain, especially if it finds its way to a very sensitive part of the body. When it shows itself externally, it is extracted very slowly for fear of breaking it, as, if that takes place, its position in the body retreats more inwardly, and causes great agony and convulsions. It is about the size of the tube of a Pigeon's quill, and has the tail terminated by a sharp trunk. The sexes are in separate animals, but the mode of propagation is a little obscure.

TRICHOCEPHALUS,—

Have the body round, thread-like in the anterior part, and terminating in a round mouth; and the posterior part of the body is considerably thicker.

T. dispar, is the most common species. It is from an inch to two inches in length, and thick for about the last third. The thick part of the male is spirally convoluted, and the organ of generation is conspicuous. In the female it is more straight, and has a simple opening. It is one of the worms of most frequent occurrence in the human intestines ; and, in some diseases, it multiplies very rapidly.

Trichostoma, have the anterior part of the body tapering gradually to the mouth ; and *Oryuris*, has the tail slender and thread-like. One species of the latter, *O. curvata*, from an inch to three inches long, is found in the cœcum of the Horse.

Cucullanus, has the body cylindrical, but thinner in the anterior portion. The head is blunt, and enveloped in a sort of hood. This genus has hitherto been found in the intestines of Fishes only. One species, *C. lacustris*, is common in the Perch, the Pike, and other Fishes. It is about an inch long, about the thickness of a thread and

appears red from the blood with which the intestine is usually gorged. An analogous species, found on the Eel, was long mistaken for the young of that animal.

Ophiostomus, have the body formed as in the preceding, but the mouth cleft across, which gives the appearance of two lips. *O. cystidicola*, is found in the air-bladder of some Fishes.

ASCARIS (the Ascarides),—

Have the body round, and slender toward each extremity. The mouth is furnished with three fleshy tubercles, among which there is a short tube, which the animal can protrude as occasion requires.

The species are numerous, and inhabit the intestines of many animals. The females, which are far more numerous than the males, have the intestinal canal straight, and an ovary divided into two branches, which is several times longer than the body, and opens by a single oviduct at about one-fourth of the length from the anterior extremity. The males have also a single vessel, very long, and with the external organ, which is near the tail, sometimes double. Two white filaments, one extending along the back, and another along the belly, have been considered as nerves; and two thicker ones, extending along the right and left sides, have been considered as muscles, as a circulating system, and even as a breathing apparatus. Some species, as *A. lumbricoïdes*, have the head without lateral membranes. This species is found, without any remarkable difference, in Man, in the Ox, the Hog, and all the varieties of the Horse family; it has sometimes occurred fifteen inches in length. It is naturally of a white colour; and, from what has been said of its reproductive organs, its power of multiplication is excessive. It occasions disease, and even death, especially in children, or in all cases where it ascends from the intestines into the stomach. *A. vermicularis*, which has a small membrane on each side of the head, is very common in children, and also in adults, when afflicted with certain diseases. It chiefly inhabits the rectum, at the extremity of which it causes intolerable itching. Its length is not more than half an inch, and its body is thickest in the anterior part. It is an exceedingly active little animal, and derives its name from the Greek verb, "to leap, or move."

STRONGYLUS,—

Have the body round, and the vent of the male inclosed in a sort of purse variously formed, which is regarded as the sheath of the organ of generation, which can be protruded from it. The female is without this apparatus, and thus more nearly resembles the Ascarides.

Some species have the mouth ciliated, or toothed, among which is *S. equinus*, which is about two inches long, with a hard spherical head, small soft spines round the mouth, and three lobes in the caudal appendage. It is very common in the intestines of the Horse; and, so far as is known, in those of all the solipede family of pachydermatous animals. Sometimes it makes its way to the arteries, and there occasions aneurisms, and other unpleasant diseases.

Other species have the mouth with tubercles, or papillæ, and among these one of the most remarkable is *S. gigas*, the largest worm which is known to inhabit the intestines of any animal. It grows to the length of two or three feet, and is as thick as the little finger. It is usually found in the kidneys of various animals, as the Wolf, the Dog, the Marten, and even Man; where it is coiled up, and inflates the organ, causing great pain. Sometimes small ones pass off with the urinary discharge. It is not, however, confined to the kidneys, but is met with in other viscera. Its usual colour is a fine red; the mouth has six papillæ; the intestine is straight, with cross furrows; the ovary is simple, and three or four times the length of the body. It is understood to have a posterior opening, and also one near the mouth. M. Otto has considered a slender white thread, which passes along the abdomen, as being the nervous system.

Spiropterus, have been separated from the Ascarides. They have the termination of the body spiral, with two wing-like membranes, between which is the reproductive organ. One species is occasionally found in the human bladder, and another in the stomach of the Mole,—to the villous coat of which it attaches itself by a small tubercle. *Physoloptera*, has a small bladder between the wing-like membranes. *Sclerottoma*, has the mouth furnished with six small scaly plates. It is found in the Horse and the Hog *Liorhynchus*, has the mouth in the form of a small proboscis, with which it penetrates the cavity of the viscera.

Pentastoma, have the body flattened, and sharp in the sides, and the transverse rugæ crenulated. The skin is thin and weak; the head broad and flat, with the mouth beneath, and a longitudinal slit on each side, from which issue the hooks whereby the animal adheres. The intestine is straight, and the reproductive organs long and tortuous. A white filament surrounding the mouth, and two filaments which proceed from it, appear to be the nervous system. One species, *P. tænioïdes*, occurs in the frontal sinuses of the Horse and Dog, and attains a length of about six inches. *Prionoderma*, resemble the former, only the mouth is terminal, and has two small hooks.

Cuvier includes the following genera of intestinal worms in this order, but gives it as his opinion that, when they are better known, they will require subdivision as a distinct family.

LERNÆA,—

Have the body resembling the former both in its external and its internal organisation; but it is prolonged into a sort of neck of a horny consistency, at the end of which is the mouth, variously armed with plate-like appendages. It insinuates the mouth and these appendages into the gills of fishes,

remains fixed there, and lives upon their blood. They contain two cords, sometimes of equal length and at others long, and even doubled, which appear to be ovaries.

Lernæa, properly so called, have the body oblong; the neck long and slender, and the head surrounded by a sort of horns. *L. branchialis*, is the best known; it infests the common Cod, and other fishes of the same family. Its neck and head, the latter furnished with three hooks, are dark brown. It fixes itself firmly in the gills, and adheres with the body bent in the form of the letter S. *L. acularis*, which is more slender, and has two long and two short horns, attaches itself to the eyes of Herrings and other fishes. *L. multicornis* has been found on the gills of a Serranus in the eastern seas.

Penella, have the head inflated; the neck horny, with two short hooks on the nape; the body long, furrowed across, and ending in slender filaments resembling the plume of a feather. *P. filosa*, which is seven or eight inches long, insinuates itself into the flesh of the Sword-fish, the Tunny, and other species, and causes them such torment that they often dash themselves on the shore.

Sphyrion, have hooks at the mouth; the head extended longitudinally like a hammer; the neck slender; and the body flattened and heart-shaped.

Anchorilla, attaches itself to the gills of fish by means of a single hook on the under part, which is directed backwards.

Branchiella, has two protuberances supporting the hook, by which it attaches itself. [One species, *B. Salmonia*, infests Salmon, while they are in the sea, but drops off after they come into the fresh water.]

Clavella, attach themselves by the mouth only; and Cuvier was of opinion that these two groups may be united with the *Lerneomyzæ*, or Sucking Lernæa, of De Blainville.

Chondracanthus, besides the hooks at the mouth, have the edges of the body variously notched, or toothed; some have a sort of two arms on each side; some have many branched ones; and others have a slender neck, and deep notches in the sides of the body.

Nemertus, which may one day require to be made a separate order, are very soft-mouthed, slender, and long, with the anterior extremity blunt, and the mouth large. The intestine extends the whole length of the body, and is accompanied by the ovaries, which open near the mouth. One species, *N. Barlasii*, is more than four feet long; it lurks in the sand, and sucks various Mollusca out of their shells. It occurs on the coast of Cornwall.

Tubularia and *Cerchrotula*, of Renieri, and *Ophiocephalus* of Quoy and Gaymard, appear to be analogous; but little concerning them is known.

THE SECOND ORDER OF THE ENTOZOA.

PARENCHYMATA.

This order includes all these Entozoa which have the body filled with a parenchyma, or pulpy matter, either in a cellular tissue, or simply in the cavity, in which there is no alimentary apparatus to be discovered, except a few canals, which carry nourishment to all the parts, and which, in the majority of cases, originate in external suckers. The ovaries are also imbedded in the parenchyma; there is no abdominal cavity, no intestine, and no vent; and the signs of a nervous system are few and doubtful. The order admits of division into four families.

THE FIRST FAMILY OF THE PARENCHYMATA.

THE ACANTHOCEPHALA.

These have a prominence, which appears to act as a sort of proboscis, and they attach themselves to the coats of the intestines by means of the recurved spines with which the proboscis is beset. They form but one genus,

ECHINORHYNCHUS,—

Which have the body round, in some instances long, and in others shortened to a kind of sac. The proboscis, by the hooks on which they attach themselves, is extensile, and contains a papilla, which may be an organ of absorption; but the animal appears to absorb moisture by its whole surface. The only vestiges of internal viscera are two small cœca attached to the base of the proboscis, and a longitudinal thread which some regard as a nerve, and others not. Some species have an oviduct, but in others the ova are diffused through the parenchyma. In the males, the organs are more distinct; and they most likely impregnate the ova after they are excluded. They often perforate the coats of the intestines, and are found in their substance, or adhering to their external surfaces.

E. gigas, is the largest known species; it is found in the Hog and the Wild Boar, and the females are sometimes fifteen inches long. *E. hæruca* is a smaller species, with only one row of spines on the proboscis. It has beer found in the liver of the Cat.

THE SECOND FAMILY OF THE PARENCHYMATA,—

THE TREMADOTEA,—

Have the under part furnished with cup-like discs, or suckers, by which they adhere. Those which are parasitical in other animals, may all be included in one genus,—

FASCIOLA,—

But it admits of subdivision, according to the form and arrangement of the suckers.

Festucaria, with only one sucker upon or under the anterior part. They are found in various birds, reptiles, and fishes.

Amphistoma, with a sucker at each end, in various vertebrated animals.

Caryophyllæus, have the head broad, winged at the margin, with a two-based sucker underneath, and sometimes another on the opposite end of the body. One species is known, and it infests fresh-water fishes, especially the Bream.

Distoma, has a sucker at the anterior extremity, and another on the under part, a little farther back. The species of this genus, or rather subgenus, are very numerous, and inhabit many animals; some of them even the wrinkled membrane surrounding the eyes of birds; but there appear to be others in salt water or fresh, which are not parasitical upon any animal.

Distoma hepatica [the Fluke, so called from its shape, is but too well known as infesting the liver of the Sheep, and if not occasioning "the rot," at least greatly aggravating its symptoms, and accelerating its progress.] It is also found in other ruminants, in the Horse, the Hog, and even in Man. It is from three quarters of an inch to an inch and a quarter in length, and its form is that of an oval leaf, pointed at the posterior extremity, and with a narrow portion at the anterior. The first sucker is at the base of this narrow portion, and leads to two branched tubes. Behind the sucker, there is an erectile tentaculum, which appears to be the male organ; and behind this is the second sucker. The mineral vessels are convoluted through the middle portions; and the ovaries are also diffused through the body, and open near the male organs As in many of the Mollusca, all the individuals appear to be bisexual, and have a mutual coitus. [The eyes are placed on the most conspicuous part of the head, and like the eyes of birds, they are provided with horny rings, by means of which they command a great range of focal lengths. Some naturalists have considered the ramified tubes which proceed from the sucker as circulating vessels; but this seems a mistake, as the convoluted vessels which the same naturalists have looked upon as intestines, are the seminal vesicles and ovaries. The power of multiplication in these animals is immense; and the ducts of a single liver have been found to contain more than a thousand, while the germs are quite innumerable. Though they accompany the rot in sheep, they do not appear to cause it, neither does their multiplication appear in all cases to render it more mortal, for sheep have died of rot with not more than a dozen of Flukes in the liver, while others have been alive with hundreds. Those sheep which are in the best condition, always have Flukes in them in the autumn; but they are also the ones most subject to the rot. It is probable that these Flukes, or at all events the germs of them, exist in the water, or on the plants of humid and marshy places; at all events, even the healthy sheep drop a few of them in the winter months; and the deceased ones vast numbers; and thus the rotten sheep taint both the flock and the pasture.] *Echinotoma*, have hooks on a projecting tubercle.

HOLOSTOMA,—

Have one half of the under surface of the body concave, and acting as a sucker. They are found in some Mammalia and birds.

Hexastoma, have the body flattened underneath, with six suckers on the under part. They are found in fishes, in reptiles, and even in the human body, in very peculiar situations.

CYCLOCOTULA,—

Have eight cups ranged in a circle on the lower part of the body backwards, and a small proboscis in front. One small species, *C. beloni*, has been found parasitical upon the common Sea-pike, *Belone vulgaris*.

Tristoma, is another subgenus, which resembles the Flukes. The body is broad and flat, with a pedunculated sucker on the under part, and two small ones anteriorly a little in advance of the mouth. There is a circular ramified vessel, the function of which is not well known, embedded in the parenchyma of the body. *T. coccinea*, about an inch broad, and of a bright red colour; attaches itself to the gills of the Sword Fish, and other large species.

Hectocotylus, is one of the most singular genera in this family. The individuals are long worms, thick, but compressed in the fore part, and having the whole of the under surface covered with suckers, arranged in pairs; and there is a sac at the posterior extremity, containing the folds of the oviduct. Some of the species are four or five inches long, and they are chiefly parasitical upon the Cuttle-fishes.

Apsidogaster, should best occupy this place in the system. It has the under-side formed into projecting laminæ by four rows of little furrows. One small species, found on Mussels.

PLANARIA.

This genus, though not inhabitants of the interior of other animals, but of the waters, are yet so similar to the Flukes in appearance and organisation, that this was the best station for them. Some inhabit fresh water and others salt.

Their body is depressed, parenchymatous, and has no distinct abdominal cavity. The mouth, which is in the middle of the lower part of the body, or a little nearer the tail, is, as in the Fluke, dilated into a sort of proboscis, and leads to ramified vessels. They are bisexual, and in their manner of reproduction have very much similarity to the Flukes, and they appear also to be similar in the structure of their eyes. They are exceedingly voracious, and will even feed upon their own species. They multiply rapidly in the ordinary way, and also by division of the body—even spontaneous division, as is alleged. Mutilated parts are also very readily reproduced, and a partial division of the body will even produce an animal with two heads or two tails, according as the anterior or posterior end is cleft. Several species inhabit the fresh waters; but larger ones are met with on the sea-shores. [Their appendages vary; but it is not easy to say what is specific and what accidental.]

M. Dugès separates from the true Planaria, *Prostoma*, which have an opening at each end of the body; and *Derastoma*, in which there is one opening, nearer the anterior than in Planaria.

THE THIRD FAMILY OF THE PARENCHYMATA,—

TÆNIOIDEA (The Tape-worm Family).

This family includes all the Intestinal Worms which have two or four suckers on the head. The space between these is, in some cases, marked by a pore; and in others, drawn out into a sort of proboscis, naked, or armed with spines. In some instances, there are four little probosci armed in this manner.

TÆNIA,—

The Tape-worms, commonly so called, form the most numerous genus, and are, unfortunately, but too well known. They have the body long—often exceedingly so, flat, and composed of a number of joints, or articulations, more or less marked; they are thinner anteriorly, and generally have a square head, with four small suckers. Some have thought that they have discovered canals ramifying from the suckers, and winding along the joints of the body. Each joint has two pores, differently situated in the different species, which appear to be the orifices of ovaries, situated in the thick parts of the joints, sometimes simple and sometimes ramified. The Tape-worms are among the most cruel enemies of those animals in which they breed, as they completely absorb their nourishment and exhaust their substance. Some have no projecting part among the four suckers. Among these is

Tænia lata, or *Tænia vulgaris*, the Common Tape-worm, which has the joints broad and flat, with a double pore in the middle of each flat side. They are often twenty feet long, and specimens of more than a hundred feet have been observed. The principal part of the length is about an inch broad; but the portion toward the head is considerably narrower. They are exceedingly annoying, and so tenacious of their hold that the most violent remedies are sometimes unable to expel them.

Other species have the prominence between the suckers, but with little radiating points. Of these,

Tænia solium, the Solitary Worm, is one of the most annoying to the human species. The joints, with the exception of those in the anterior part, are longer than in the Common Tape-worm, and they have the pores alternately on the opposite sides. The most common length is four or five feet; but much longer ones are sometimes met with. The detached joints are called *cucurbitini*. That only one can exist in one human body at the same time is a vulgar error. Of all Intestinal Worms, they are the most dangerous, and the most difficult to expel.

Several genera, or subgenera, are distinguished from the true Tænia by the form of the head, and others by a vesicle at the termination of the body. About five genera have the head different.

TRICUSPIDARIA,—

Have the head formed into tubes, and each side has, instead of a sucker, three very sharp-pointed spines.

Only one species, *T. nodulosa*, is known. It infests the Perch, the Pike, and various other fishes.

BOTHRYOCEPHALUS,—

Have two longitudinal grooves on the head instead of suckers. They infest various fishes, and some birds.

DIBATHRYORHYNCHUS,—

Have two little probosci, or tentacula, on the head, bristled with small hooks.

FLAVICEPS,—

Have four tentacula, with curved spines, with which they penetrate the substance of animals. Some have the body retractile into a membrane, and others not. One, which infests the Skate family, is several inches long, and has the head shaped like a flower.

TETRARHYNCHUS,—

Resembles the head and the first two joints of the preceding. One species of it infests the tongue of the Turbot. *Tentacularia* differ only in wanting the spines on the tentacula.

Those which have the head with four suckers, but the body terminating in a sort of bladder, and the joints very obscure, are also with propriety separated from the true Tape-worms.

CYSTICERCUS,—

Or *Hydatids*, have the bladder supporting one body and head. They are very numerous, and found in the membranous and cellular substances of many animals. They are very common in Ruminants, and many other Mammalia, as in the Hare, the Rabbit, the Hog, various species of the Quadrumana, and even in Man.

One species, *C. cellulosa*, occurs in vast numbers among the muscular fibres of the Hog, and produces, or accompanies, the disease in that animal which is known by the name of the Measles, and renders the flesh both unpalatable and unwholesome. It is small, breeds rapidly, and finds its way to all parts of the body, even to the heart and the eyes. It is said, however, that they have never been found in the Wild Boar, which proves that they, or the disease which favours their developement, are induced by the very artificial manner in which tame Hogs are bred. Those found in the Quadrumana and in Man are very analogous. *Acrostoma*, found in the amnios of the Cow, is very nearly allied.

Cœnurus, have several bodies and heads attached to the same bladder. *C. cerebralis*, is well known as infecting the brain of the Sheep, consuming the substance, and occasioning the disease called the "staggers," in which the animal totters round and round toward the affected side, but without any alleviation of its suffering. Other species infest the Ox and other ruminants, and they all produce the same sort of effect; but, as scarcely any ruminant is so susceptible of change by artificial means as the Sheep, they are most severe upon it. In some instances the bladder is as large as an egg, with thin walls, susceptible of contraction; but the bodies and heads are small, and can be almost entirely withdrawn into it.

SCOLEX, Linn.

The body round, contracted to a point posteriorly, and have a variable head, with two or four suckers The inflated part is very contractile. Most of the species are small, and live on fishes.

THE FOURTH FAMILY OF THE PARENCHYMATA,—

THE CESTOIDEA,—

Comprises those which are destitute of external suckers. This consists of only a single genus,—

LIGULA.

These are the simplest in their organization of all the Entozoa. The body is like a long, flat ribbon, with one longitudinal stria, and numerous cross ones; and the internal parenchyma appears to contain nothing but the ova distributed through its substance. They are chiefly found in the abdomen of birds and fresh-water fishes, whose bowels they envelope and contract in such a manner as to destroy them; and at certain periods they perforate the abdomen, and leave it.

One species, *L. abdominalis*, infests the Bream; and, in some parts of Italy, it is considered agreeable food.

[It will be perceived that the whole of the Entozoa are remarkable for the great developement of their reproductive system; and not a few of them for the great and rapid growth of the individual; and this is exactly what analogy would lead us to suppose. Living, not only in the bodies, but upon the living, or already assimilated substance of other animals, the labours which they have to perform are few and simple, compared with those of most of the animal creation. They have but little use either for locomotion or sensation; and they have probably less for circulation, respiration, or digestion, excepting in the Planarii and any others which do not live in the bodies of other animals. As their habitations are obscure, their habits are equally so; and the purpose which they answer in the economy of nature is quite a mystery.]

THE THIRD CLASS OF THE RADIATA,—

THE ACALEPHA,—

Includes all those Radiated Animals which swim in the waters of the ocean; and in which we can still perceive vessels, though these vessels are, in truth, little else than intestinal tubes, ramified through the parenchyma of the body. They admit of a natural division into two orders,—Simple and Hydrostatic.

THE FIRST ORDER OF THE ACALEPHA.

THE ACALEPHA SIMPLICIA.

These float and swim in the water, by alternate contractions and dilatations of the body, although their substance is merely gelatinous, and without any apparent fibres. The apparent vessels found in some of them are only hollows in the gelatinous substance originating from the stomach, and offering no proof of a true circulation. There are obvious points of resemblance among them all; but still they admit of division into genera and subgenera.

MEDUSA,—

Have a central disc, more or less convex, on the upper surface, something like the head of a mushroom, and termed the umbrella. The contractions and dilatations of this disc contribute to the locomotion of the animal; [but they are not powerful enough for stemming rapid currents of the water.] The margins of the umbrella, and those of the mouth, or of the suckers which supply the place of a mouth, in the middle of the under surface of the disc, are furnished with tentacula, very much varied in form and size, and these variations are the basis of many subdivisions of the genus. [They are very numerous; and the small ones give the seas in which they abound the appearance of being crowded with flakes of half-melted snow. Some of these show fine prismatic colours; and in not a few the gelatinous matter which fills the integument of the disc is of so acrid a nature as to irritate and blister the skin, even after it has been dried.]

Fig. 141.—Medusa.

Medusa, properly so called, includes all those that have a true mouth on the under side of the disc; but this mouth is sometimes a simple opening, and at other times placed on a peduncle.

Æquorea, includes those in which the mouth is simple, and not on a peduncle, or furnished with arms or tentacula. When there are no tentacula round the disc, they form the *Phorcynia* of Lamarck. When the disc is furnished with tentacula all round, they are the *Æquorea* strictly so called, and one of the most numerous in the warm seas. Some have the under surface covered with laminæ, and others have the margins of the umbrella diversified by furrows.

Pelagia, comprehends those which have the mantle produced into a peduncle, or divided into arms or tentacula.

In all these subgenera, there are no lateral cavities; but in the majority of those with a simple mouth, there are, in the substance of the umbrella, four organs inclosed in furrowed membranes, which, at certain seasons of the year, are tinged with a dark-coloured substance, understood to be the germs of the young. They are lodged in four cavities, which open near the mouth, or the sides of the peduncle; and as small animals are sometimes entangled in them, some have regarded them as mouths, and others as organs of respiration. That they are not mouths is evident, and the respiration appears to be performed by the margin of the umbrella. The tentacula, whether on the margin of the umbrella, or round the mouth of the animal, vary not only in different species, but in the different ages of the same species.

CYANEA,—

Includes all the species which have a central mouth, and four lateral ovaries.

C. aurita, is one of the most common and widely distributed species. With age, it acquires four very long arms: the margin of the umbrella is finely ciliated all round; and within it are observed reddish vessels origin-

ating in the stomach, and proceeding by ramifications toward the circumference. Another species, *C. chrysaora*, has the margin furnished with long tentacula, and rows of brown or yellow spots, forming rays on the convex surface. It is very common, and there are great varieties in the spots.

Cuvier distinguishes under the name of

RHIZOSTOMA,—

Those Medusæ which have no central opening or mouth, and which are thence supposed to draw their nourishment by suction by the ramifications of the peduncle, or by the tentacula. They have four ovaries or more.

Rhizostoma, properly so called, have a central peduncle, more or less ramified according to the species. The vessels which arise in the small protuberances of the peduncle, unite in a cavity at its base; and from this, other vessels are ramified to all parts of the umbrella, or disc. The most common species is the blue Rhizostoma, which is often left on sandy shores by the ebbing tide. The umbrella is sometimes two feet in diameter. The peduncle is composed of four pairs of arms, which are very much branched and toothed, and each is furnished with two auricles or appendages at the base, which are also toothed. A fine network of vessels, occupying the thickness of the margin, extends all round the umbrella. According to the observations of MM. Audouin and Milne Edwards, these Medusæ are social, or at least they are always met with in numerous shoals, swimming in the same direction, and with the body obliquely inclined.

The *Cepheæ* of Peron differ from the other Rhizostoma only by having filaments intromixed with the dentations, or papillæ of the peduncle. The *Cassiopeiæ* have no peduncle; and their arms, which are usually eight in number, and sometimes branched, rise directly from the under surface.

ASTOMA,—

Might be the general name for those which have no central mouth, no ramifications of the peduncle, and no cavities for the ovaries.

Some, however, have the peduncle furnished on each side with filaments that may act as suckers. Others have no filaments, but the extremity of the peduncle is hollowed out like a funnel, which seems to be the sucker, as from it vessels ascend the peduncle, and others are ramified from its base all over the body. Others again, want the funnel-shaped membrane, or it may have been mutilated before the specimens were obtained. There are still others, which have no vestige of a peduncle; but merely little suckers distributed over the under surface, on the lines of the vessels which are ramified below it; [and these suckers are, of course, so many little mouths]. Some have no vestiges of suckers or any other external apparatus, but have both sides smooth; and there are yet others which have no trace even of internal vessels. The under surface of these is usually concave, and may act as a stomach. These last are very simple animals, and differ from Hydra in scarcely anything but size.

BEROE.

This genus should be separated entirely from the Medusæ. It has a globular body, provided with salient ribs, extending from the centre of the upper surface to that of the under, and bristled with points or filaments, which appear to be connected with vessels in which there is some appearance of a fluid circulating. The mouth is on the one extremity, and leads to a stomach, which occupies the axis of the body. There are also on the sides two organs, which are probably analogous to what are considered the ovaries of the Medusæ.

B. pileus, a species very common in the Channel, has the body spherical, with eight ribs, and two ciliated tentacula, which become very long by prejection of their inferior extremities. MM. Audouin and Milne Edwards have described its natural organization with considerable minuteness, and have traced various sets of vessels, but without being able very clearly to explain their functions. This species is understood to constitute great part of the food of the common Whale. Naturalists have referred to the same genus very simple species, which consist of only a sac, furnished with ciliæ, and open at both ends. The *Doliolum* of Otto have not even projecting ribs, but resemble barrels without bottoms.

Callianiræ of Peron, differ from Beroe only in having the ribs more salient, and united two and two, so as to form two sets of a sort of wings. *Janira*, resemble the last; but they have upon each side three long ciliated ribs, and two filaments. *Alcinaceæ*, have a cylindrical body, open at the one end, and two large wings at the other, which when folded up completely cover the body. The cylindrical part is marked with four salient ribs, which end in points, and have eight braces of ciliæ. *Ocyraceæ*, have similar wings; but they have no ribs, and only four rows of ciliæ on the cylindrical portion.

CESTUM,—

Bears, perhaps, the nearest resemblance to Beroe than to any other genus. It is a very long gelatinous ribbon, having one of the sides furnished with two rows of ciliæ, and there are fainter traces of the same on the other side: the mouth is in the middle of the inferior edge, and the stomach is embodied in the gelatinous substance of the ribbon; from the anal extremity there proceed vessels which ramify toward both extremities of the ribbon; and near the sides of the mouth there are two vessels which are pro-

bably ovaries. Notwithstanding its very singular shape, this animal may be considered as resembling a Callianira, in which the wings are excessively developed.

There is but one known species, *C. Veneris*, "the Girdle of Venus," which, considered as a ribbon, is five feet long, and two inches broad; but as an animal, it is five feet broad, and two inches high. It inhabits the Mediterranean; but its substance is so tender, that it is difficult to preserve an entire specimen.

The two genera following, though long included among the Medusæ, ought rather to form a small separate family of the order, on account of the interior cartilage which supports the gelatinous substance of their body.

Porpita, have a circular cartilage, and the surface marked with concentric striæ, crossed by radiating ones. The upper surface is simply invested with a thin membrane, which projects beyond it; but the under surface is furnished with many tentacula, the external ones long, and beset with small cilia terminating in little globes; these sometimes contain air; and those toward the middle are the shortest, simplest, and most fleshy. In the middle of these tentacula the mouth is situated, in the form of a small projectile proboscis. It leads to a simple stomach, surrounded by a coat of glandular substance. There is only one known species, which is of a black colour, and found in the Mediterranean and the warmer seas.

Velella, have the mouth and tentacula like the preceding, only the latter are not ciliated. The cartilage is oval, and has a crest of some elevation passing obliquely across it, and it is transparent, without striæ. There is but one known species, which inhabits the same seas as Porpita. It is fried and eaten.

THE SECOND ORDER OF THE ACALEPHA.

THE HYDROSTATICA.

The members of this order are distinguished by one or more vessels filled with air, by means of which they keep themselves suspended in the water. Appendages, exceedingly membranous, and varied in their forms, some of them probably suckers, and others ovaries, are attached to the air vessels, and with these constitute the whole visible organization of the animal.

PHYSALIA,—

Consists of a large oblong air vessel, with an oblique and wrinkled salient crest on the upper surface, and furnished below, near one of the ends, with a number of cylindrical appendages, which have their extremities of different forms, but they all communicate with the air vessel. The middle ones are beset with groups of little filaments; and the lateral ones end in two threads each, one of which is usually very long. There is apparently a very small opening at one end of the air vessel; but there are no intestines visible, though there is an inner vessel, with a thinner tunic, from which cœca proceed to the processes of the crest; and no nervous, or circulating, or glandular system is visible. They float upon the surface of the sea when smooth, and the crest answers the purpose of a sail. When living, it has two filaments much larger than the others, which are gemmed with a sort of pearly-looking drops. When touched it stings or burns the fingers, like those Medusæ which are called "sea nettles." They are found in all the warm seas, and have been, strangely enough, confounded with Holóthuria.

PHYSSOPHORA,—

Resemble Physalia in their general characters; but the air vessel is much smaller, has no crest, and is often accompanied by lateral ones still smaller. The tentacula, which are very numerous, are suspended in a bunch under the air vessels.

The *Physsophora*, properly so called, have the secondary air vessels placed laterally under the principal one; and the tentacula are conical, cylindrical, or terminating in thread-like appendages, the last being susceptible of considerable elongation.

Hippopus, have only lateral vesicles, semicircular, or resembling the foot of a Horse. These are arranged in two rows like the grains on the spikes of certain grasses; and by their united contraction and dilatation, the animal can move with considerable velocity. [As the Physalia have been compared to little sailing boats, so these may be looked upon as a sort of steamer in miniature.] *Capulitæ*, have vesicles attached in two regular rows, often of a pretty long axis. *Racemida*, have the vessels small and globular, and united into an oval mass. *Rhizophyza*, have a single air vessel on the top of a stem, on the sides of which the tentacula are attached. *Stephanomia*, have the secondary air vessels blended with the tentacula around the stem.

DIPHYES,—

Are curious animals, different from the Hydrostatic Acalepha, and yet, perhaps, resembling them more than any other animals in the system. Two of them are always found together, one within the cavity

of the other; but they can in every case be separated without injury to the life of either. They are gelatinous and transparent, and move nearly in the same manner as the Medusæ. The containing animal produces from the bottom of its cavity a chaplet, which passes along a semi-canal in the contained one, and which chaplet appears to consist of ovaries, tentacula, and suckers, analogous to those of the preceding genera.

[These singular animals are inhabitants of the tropical and southern seas; and we are indebted for most of what we know concerning them to MM. Quoy and Gaymard.] The following are their distinctions as grounds of classification :—

Diphyes proper, in which the two individuals are similar and pyramidal, with a few points round the aperture, which is in the base of the pyramid.

Calpes, in which the received is pyramidal, and the receiver small and square.

Abyles: the received oblong, or oval; the receiver small and bell-shaped.

Cuboïdes: the received small, and bell-shaped; the receiver larger, and square.

Navicula: the receiver bell-shaped. and the received large, but something in the shape of a wooden shoe.

There are other combinations besides these; [but we know too little of the habits of the animals to be able to understand the purpose of their very irregular economy. We do not even know whether any one form is adapted for being only a received or a receiver, or whether the same form of animal may not be sometimes the one and sometimes the other; neither do we know when, how, or for what purpose the one takes possession of the other as a dwelling.]

THE FOURTH CLASS OF THE RADIATA,—

THE POLYPI,—

The Polypi are so named, because the tentacula which surround their mouths have a slight resemblance to the arms of the Cuttle-fish (*Sepia*), which was called *Polypus* by the ancients. The form and number of these tentacula vary. The body is always cylindrical, or conical, frequently without any viscera but its cavity, and frequently with a visible stomach, and with intestinal tubes which are hollowed out of the substance of the body, as in the Medusæ; and along with these tubes ovaries are usually found. The greater part of them are capable of producing new individuals by putting out a sort of buds; but they propagate also by eggs. [This twofold means of propagation appears to answer a double purpose,—the buds being produced for the enlargement of an established colony, and the eggs committed to the waters for the purpose of forming new ones.] The Polypi form three orders, which are again divided and subdivided into families, tribes, and genera.

THE FIRST ORDER OF THE POLYPI,—

THE CARNOSI—(FLESHY POLYPI).

This order includes all those fleshy animals that have the power of fixing themselves by their base; but many of them can also crawl upon that base, or detach it, and swim, or, at all events, allow themselves to be moved along by the current of the water; but the motion which they most usually perform is that of expanding or retracting the tentacula, and opening and shutting the single aperture of the body. This aperture, which is of course both mouth and vent, opens immediately to the stomach, which is a simple cul-de-sac. It has, however, a proper membrane of its own; and between this and the external skin there is a rather complicated, but obscurely known organization, consisting of vertical and fibrous leaflets, to which

the ovaries are attached in the form of tangled threads. The intervals between the leaflets have communications with the tentacula; and it should seem that water enters by these, pervades the space between the leaflets, and ultimately escapes by small openings in the circumference of the mouth; at least, some of the Actiniæ eject water in this manner.

ACTINIA.

These have the body fleshy, often brilliantly coloured; and the tentacula are arranged in several rows round the mouth, somewhat like the petals of a double flower, for which reason they have been called "Sea-anemonies." They are very sensitive to light, and expand or close their tentacula according to the fineness of the day. When the tentacula are retracted, the aperture from which they proceed closes like the mouth of a purse, and the animal appears a simple fleshy tubercle, adhering to the rock. Their reproductive powers are scarcely inferior to those of the Hydra. Amputated parts are speedily re-produced; and the numbers may be multiplied by simply dividing the body; though their usual mode of reproduction is by bringing forth the young alive. These young pass from the ovary into the stomach, make their escape by the mouth of the parent animal, and find localities for themselves. There are several distinctions among them, besides those of size and colour. All the Actiniæ are voracious, and miscellaneous feeders. Small Fishes, Crustacea, and shelled Mollusca are, however, their usual food, and they very speedily extract the contents, and eject the empty crusts and shells.

Fig. 142.—Actinia.

Actinia proper, fix themselves by a broad and flat base. There are very many species, especially in the warmer seas, where some of them are of large size, and equal in brilliancy of colour to any flowers of the garden. The species most common in Europe are, among others, *A. senilis*, which is three inches wide, with a leathery and rugged envelope of an orange colour, and two rows of tentacula of moderate length, marked with a ring of rose-colour. It is found on the sands, into which it sinks if disturbed. *A. equini*.—Skin soft, finely striated, of a bright purple, often spotted with green; body smaller than the last, but the tentacula longer and more numerous. It abounds on the coasts of the Channel, and has a beautiful appearance. *A. plumosa*.—White, more than four inches wide, mouth in lobes beset with small tentacula, and with a row of larger ones within the lobes. *A. effœta*.—Light brown with whitish streaks, smooth, lengthened,and often thickest at the upper part. Inhabits the Mediterranean, and usually fixes itself to shells. Those which have been enumerated are a mere specimen out of many species, the distinctions of which are, however, often obscure.

Thalassiantha and *Discosoma* of Ruppel, are Actiniæ, the first with branched, and the second with very short tentacula.

Zoanthus, have the same texture, mouth, and tentacula as Actinia, and differ little in their general organization; but they occur in groups adhering to a common base, which is sometimes broad and flat, and at other times a sort of creeping stem.

LUCERNARIA,—

Resemble Actinia, but are of softer substance. They fix themselves by a slender peduncle to sea-weeds and other bodies. The upper part expands like a parasol, and is surrounded by numerous tentacula, arranged in bundles; and between these are eight cœca proceeding from the stomach, and containing a red granulated matter.

L. quadricorna, has the edge in four forked branches, with two bundles of tentacula in each. *L. auricula*, has the border octagonal, with a bundle of tentacula in each division.

THE SECOND ORDER OF THE POLYPI.

GELATINOSI.

These have no firm envelope, and no ligneous, fleshy, or horny axis within the body. They are wholly gelatinous, more or less conical, and the simple cavity serves for a stomach.

HYDRA.

These are the simplest of all animals in their organization, the whole of which consists of a small, gelatinous horn, beset with filaments which serve as tentacula. Even the microscope finds nothing in their bodies but a transparent parenchyma, containing mere opaque granules; still they can swim and crawl, and even walk, by attaching the ends of the body alternately in a manner similar to Leeches and geometrical Caterpillars. They disturb the water with their tentacula, and thus bring their prey within

their reach. Light affects them very powerfully, and they are fond of it. By division of the body they may be multiplied to an indefinite extent; but their natural production is by buds, which shoot out from various parts of the parent animal, and drop off when they are matured. They are found in stagnant waters, usually under the floating leaves of aquatic plants; and it is understood that they tend to purify the waters. Some are green, others of a grey colour, and they vary also in size.

Corine, have a fixed stem and oval body, open at the summit, and covered with little tentacula. Their texture is firmer than that of Hydra; some of them carry the ova on the under part of the body, in a manner similar to that of some Crustacea and Arachnidæ.

Cristatella, have over the mouth a double range of numerous tentacula, forming a sort of plume in the shape of a half-moon, the regular motion of which brings food to the animal. These mouths are on short necks attached to a gelatinous body, which moves somewhat similar to Hydra. They inhabit stagnant waters; but to the naked eye, they appear only as little spots of mould.

Vorticella, have the stem fixed, often much branched and divided, with a bell or horn-shaped termination to each branch, and two opposite groups of filaments, which agitate the water. They abound in stagnant fresh waters, and are arranged as bushes, shrubs, plumes, and other agreeable forms; but they are too minute for being seen by the naked eye.

Pedicellaria, are found between the spines of Echini, and by some considered as organs of these animals, but the probability is that they are Polypi, which seek shelter there. They consist of a slender stem, with a horn on the tip, furnished with tentacula like minute threads or leaves.

THE THIRD ORDER OF THE POLYPI.

CORALLIFERI.

These include all those numerous species, which were for a long time regarded as marine plants, and in which numerous individuals are so united as to form compound animals, for the most part fixed like plants by a branched stem, or by simple expansions of a solid substance, at the base, or in the middle of the group. The individual animals, which are more or less analogous to Actinia and Hydra, are all connected in a common body, and have a general nutrition, so that whatever one eats, tends to the nourishment of the common body, and of all the individuals. Their instincts appear also to be common, at least in those species which have free motion in the water, for they swim by the joint action of the general body, and of all the Polypi. *Polypidom* (the House of the Polypi), is the name usually given to the common part of these compound animals; but the name is not quite correct, inasmuch as the common part is sometimes internal, and sometimes external. These polypidoms are formed in layers by deposition, somewhat similar to the ivory of teeth; and they are of various degrees of hardness; the hind parts being composed of salts of lime, but always united by means of animal matter, in the same manner as the lime in bones, crusts, and shells. The differences of form and situation in the polypidoms, gives rise to many divisions and subdivisions.

THE FIRST FAMILY OF THE CORALLIFERI.

THE TUBULARIA.

These inhabit tubes which have a common gelatinous stem pervading the axis, like the pith of a tree; and the tubes open sometimes on the summit, and sometimes at the sides, for allowing a passage to the Polypi. These Polypi are individually very simple, and resemble in their organization Hydra and Cristatella.

They form three principal genera, but each admits of subdivision.

TUBIPORA,—

Have the tubes simple, and of stony consistence, each containing a simple Polype, and arranged parallel like the pipes of an organ.

T. musica, abundant in the Oriental Archipelago, has the tubes of a fine red, and the polypi green and like Hydra. Some fossil polypidoms, such as *Catenipora*, in which the tubes are disposed in meshes, and *Favosites*, where they are crowded and hexagonal, resemble this genus.

TUBULARIA,—

Have the tubes of a horny substance, and simple, or branched; and tne polypi come out at the extremities only. Many of them are found in stagnant fresh water, on the surfaces of plants.

Tubularia marina, have two ranges of tentacula, the exterior as rays, and the interior a tuft. *T. indivisa*, found in the European seas, have the tubes about two or three inches long, resembling bits of stone. *Tibiana*, have the tubes in zigzag, with a small opening at each angle. *Cornularia*, have the tubes conical, and the polypi have eight toothed tentacula. *Anguinaria*, have small cylindrical tubes, adhering to a creeping stem, with an opening near the extremity for the polypus. *Campanularia*, have the terminal habitations of the polype bell-shaped. Some have the branches of the bell smaller, and others have climbing stems.

SERTULARIA,—

Have a horny stem, simple or branched, with the cells for the polypi on the sides. The common gelatinous stem forms the axis of the horny one. They propagate by buds, which are produced in larger cells. The dispositions of the cells have caused various subdivisions.

Aglaophenia, have the cells on one side of the branches. *Amatia*, have the cells partially united, and in some cases forming a sort of spire. *Antennularia*, have the cells in horizontal whirls; and *Sertularia* proper, have them alternate or opposite, on both sides of the stem.

THE SECOND FAMILY OF THE CORALLIFERA,—

THE CELLULARIA,—

Have each polype adhering to a horny or calcareous cell with thin walls, and no apparent connection with each other, except by a very thin epidermis, or by pores in the walls of the cells. The polypi in general resemble Hydra.

Cellularia, have the cells arranged in the form of branched twigs, but no communicating axis, and the substance of their stems is more calcareous. There are several subdivisions.

Crisia, with cells in two ranks, generally alternate, and opening on the same side. *Acamarchus*, with a vesicle at each opening. *Loricula*, with two cells opposite, placed back to back. *Eucratea*, with one oblique cell on each articulation. *Salecorniaria*, with the joints of the stem hollow, and their surfaces studded with cells in quincunx.

Flustra.—This genus consists of many cells, united in clusters like a honeycomb, sometimes covering various bodies, and sometimes forming leaves or stems. Some species have cells on one side the leaves only.

Cellepora, have numerous small calcareous cells, crowded upon each other, and each pierced by a small opening. *Tubulipora*, are masses of little tubes with wide openings.

There are bodies in the sea, which resemble the Coralliferi, or Polypi having stems or polypidoms, in which no polypi have yet been discovered. Pallas, and other naturalists of name, have considered them as plants; but others regard them as polypidoms, in which case they belong to this order. They form one great genus, with many subdivisions. This genus is

CORALLINA (the Corallines),—

Which have articulated stems, supported on a kind of roots and branching again and again, but having no pores in their substance, or visible polypi.

Corallina proper, have the calcareous joints of uniform appearance, and there is no sign of epidermis or bark. The bottom of the sea on certain coasts is covered with these like a thicket of bushes, having the joints oboval, and the sprays arrayed like pinnate leaves. The colour is white, or reddish, or greenish. It was once used in medicine, though only on account of the salts of lime which it contains. *Amphiræa*, has the joints elongated. *Jania*, have them slender, and with less calcareous matter. *Cymapolia*, has the calcareous joints separated from each other by portions of horny matter, and pores more distinctly marked than most of the others. *Penicilla*, have the interior of the stem composed of a tissue of horny threads, with an external calcareous crest investing the whole. The stem terminates in a bundle of articulated branches, resembling those of the other Corallines. *Halymeda*, have the stems and branches composed of joints externally, like the others; but internally they have a corneous tissue, from which the cutaneous matter is easily separable by acids. *Flabellarius*, have no distinct joints; but consist of large leaf-like expansions, which have their stems of the same consistency as those of Halymeda. *Galaxura*, have the stems hollow, and branching into two. *Lingora*, resemble the last, but have no articulations in the stems. *Anadiomena* (Corsican Moss), is articulated and branched, and consists of a horny substance, with a gelatinous covering. It is much used for expelling worms. *Acetabulum*, is in form one of the most singular of the Corallines. It consists of a slender stem, supporting a round thin plate like a parasol, which has a round smooth disc surrounding the central pores, the outer portion marked with striæ, and the margin crenulated. No polypi have been discovered in their pores; but the rays of the striated disc are hollow, and contain greenish granules, which led Cavalini to conclude that it is a vegetable. *Polyphysa*, have a hollow stem, with a bundle of small closed vesicles on the summit. This has also been considered a vegetable.

[As the Corallines are situated on the very border, the indefinite border we may say, which separates the animal kingdom; and as many zoologists and botanists are fully as zealous for an extension of territory, as for understanding and governing well that which unquestionably belongs to them, the Corallines are, like sponges, claimed, and taken and retaken by both parties. The real cause of this, is the apparent impossibility of arriving at a true definition of what constitutes a plant or an animal, or what is the specific and unequivocal difference between the one and the other. Baron Cuvier, who was one of the most cautious as well as the most profound of zoologists, rarely speculates beyond the facts, and never enters into warfare on debateable ground. There is enough, however, even in his short synopsis, to show that the Corallines are really animals, although their polypi have not been discovered, and even although there should be none to discover. From the exceedingly varied structures of animals, and more especially from the extremely simple organization of some of those of the present grand division, we can easily see that no one organ of the higher animals is necessary for carrying on the functions of animal life, in some manner or other. The Hydra is a remarkable instance of this; for, simple as it is in its structure, it is far more instinct with life than those which, according to our types, we are disposed to consider as the most perfect animals; and, from the functions which it can perform with its simple organization, we cannot help concluding that there may be animals still more simple, and that a mere epidermis, or fibre, or any other nameable part however simple, may contain in it all the principles of life and reproduction. In addition to this, which we grant is only hypothesis, though very probable hypothesis, we may remark, that it cannot have failed to strike the attentive reader that all the substances elaborated by these Corallines are of an animal nature, not a vegetable one. The hard parts of them are always composed of salts of lime, the cement of which is an animal gelatine, and the soft parts are also animal. In the most plant-like of them there is no substance in the least resembling that of the plants with which they agree most in form; and as little is there any substance similar to theirs in the most analogous of the true vegetables. This may be considered as coming as near to absolute proof of the animality of these productions, as analogical reasoning can come. Indeed, what need we more? For, though we should discover Polypi upon the Corallines, all that we could conclude from that would be that they were compound animals, with a sort of heads and mouths; whereas, according to our present knowledge of them, they are animals without either: and, as we find animals of other genera equally deficient of those parts, we have no reason to conclude that the Corallines may not be also without them. The fact is, that the subtle arguments which are sometimes raised to prove the animality of animals, always tend to the proof of quite another position, namely, that the animal in question is not itself, but some other one, having different organs, or parts, of some kind or other. For want of the fundamental definition to which we have alluded, it is impossible to argue upon what is animal or what is vegetable, abstractedly from the description of that matter of which the subject in question is composed. Therefore we have no foundation upon which to build, but the matter of which the subject under consideration is composed; and though there are some difficulties even here, yet the line of distinction is, upon the whole, pretty broad and definite, although, perhaps, it is not easily described in words. No man, however, who possesses ordinary discernment, can confound the hard matter of a plant with that of an animal; and though, externally, many of the Corallines resemble bushes, or branches, the substance of them is no more like wood than it is like the horns of a Deer. The argument now used is equally applicable to the Sponges; and though it is not demonstrative in the present state of our knowledge, and probably never will become so in any state of it, yet it comes as near to demonstration as any thing that we can obtain upon mixed questions, in which life, either animal or vegetable, is involved.]

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This family includes all the genera in which the whole of the Polypi of any one Polypidom are obviously connected by a common substance, of a thick, or fleshy, or gelatinous consistency, in cavities of which the individual developements of the polype are contained; and they, and the containing membrane, or skin, are supported by an internal axis, or core, varying in form and consistency, in the different members of the family. The polypi of such as have been observed are a little more complex in their organization than those of the preceding families of this order, and bear a good deal of resemblance to Actinia. They have a distinct stomach, from which eight intestinal tubes proceed; and of these two long ones penetrate the common mass, and two shorter ones appear to be ovaries. They are divided into four tribes, *Ceratophyta*, *Lithophyta*, *Natantia*, and *Spongia*, chiefly on account of the form and texture of the supporting substance.

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Gorgonia, have the horny or fibrous part of the axis invested with a covering so thick, and so full of calcareous

granules, that it dries entire on the axis, and retains its colours, which are often very bright and beautiful; but it is soluble in acids. The Polypi of several species have been examined, and found to have eight toothed tenta, cula, and a stomach and other viscera, like those of Corollium.

Among them, M. Lamouroux distinguishes *Plexaures*, which have the covering membrane thick, with the cells not prominent, and it effervesces but slightly with acids; *Ermicen*, which have the same back, but the cells of the polypi prominent; *Murisen*, which have the covering of moderate thickness, with projecting mammillæ covered with rough and imbricated scales; and *Primnoa*, in which the mamillæ become imbricated by the one hanging partially over the other.

LITHOPHYTA,—

The second tribe, have a fixed internal axis of stony consistency. The leading genera are, *Isis*, *Madrepora*, and *Millipora*; but they admit of subdivision.

Isis, have the axis branched, and no cells or cavities on its surface; and the internal tunic of gelatinous matter is mixed with calcareous particles, as in Gorgonia.

Corallina [*Isis nobilis* of Linnæus], is the Coral of commerce, so much admired for its fine red colour, and the high polish of which it is susceptible, and so often made into trinkets. There are very profitable fishings (or divings) for it in different parts of the Mediterranean. The covering is of a reddish colour, and contains calcareous matter. The polypi have eight toothed arms, or tentacula. *Melita*, has the stony axis interrupted by nodes full of a substance of the consistency of cork. *Isis*, properly so called, has the horny part knotty; and the bark thick, soft, and easily removed after death. *Mopsia*, has the bark much thinner, but also stronger.

MADREPORA (the Madrepores),—

Have their stony substance sometimes branched, and sometimes in rounded masses, or in leaves; but it is always furnished with laminæ, concentrated toward points in the form of stars, or terminating in lines more or less serpentine. During life the stony part is enveloped in a horny bark, which is soft and gelatinous, and roughened by rosettes of tentacula, which are the Polypi, or rather the Actiniæ, for they have more than one row of tentacula. The laminæ of the polypi have some slight resemblance to those on the stony case; and the covering and polypi contract a little upon being touched.

The varieties of their general form, and the figures which are produced by the combinations of their laminæ, have been made the foundation of numerous subdivisions; but several of these run into others, so that they are not absolutely specific, and it will be impossible to fix them definitely until the relations between their forms and the polypi are known.

When there is only a single star, circular or elongated, with many laminæ, they are the *Fungia* of Lamarck; and their polype resembles a single Actinea, with numerous tentacula; and the opening of the mouth corresponds exactly with the point toward which the laminæ converge.

There are found among fossils stony polypidoms consisting of a single star, which appears never to have adhered to others. These are the *Turbinata* and *Cyclolithus* of Lamarck, and the *Turbinolopsis*, Lamouroux.

When the Madrepore is branched, and the stars are confined to the extremities of each branch, it is the *Caryophyllia* of Lamouroux. The branches are striated, and each star answers to a mouth surrounded by many tentacula.

Oculina, have the small lateral branches very short, which gives them the appearance of having stars along the branches, as well as on the extremities. *Madrepora*, or Madrepores properly so called, have the whole surface roughened by little stars. *Pocillopora*, have little stars with pores in the intervals; and *Serialopora*, have their stars in lines. *Astrea*, have a broad and generally convex surface, hollowed by crowded stars, each having a polype with numerous tentacula in a single row, in the centre of which is the mouth. *Explanaria*, are broad, with the stars on one side. *Porites*, has the stony substance branched. *Meandrina*, have the surface formed into little hills and valleys. In each valley there are mouths; but the tentacula, instead of forming stars or rosettes around them, are ranged along the sides of the valley. In some, however, the mouths are merely festooned. If the hills which separate the valleys are raised into crests furrowed on both sides, they are called *Pavonia*; and mouths, usually without tentacula, are found in the valleys, the crests probably acting as substitutes for the latter. There are also others, which have these hills conical or star-shaped, and the principal distinction of them is having the polypi on the projecting parts or in the hollows. *Agaricina*, are composed of laminæ, having valleys only on the one side, and the sides of the valleys furrowed. It is probable that we should consider as nearly allied to the Madrepores, certain polypidoms composed of cylinders, the sections of which form stars. These are *Sarcinula*, and when they have a solid axis, they are perhaps nearly allied to Tubipora, in the first family of the order.

MILLIPORA,—

Which compose the third genus, have the stony portion much diversified in shape, and the surface scooped only into small holes or pores, and sometimes there are no apparent perforations. *Distichopora*, have strongly marked pores on two sides of the branches. *Millipora* proper, are solid and variously branched. Sometimes the pores are not discernible, and they are *Nullipores*. *Eschora*, have flattened and leaf-like expansions. *Retepora*, are Eschoræ pierced like a net-work. *Adeona*, are Eschoræ on articulated stems, entire, or pierced like a net-work.

NATANTES,—

Which form the third tribe of the coral family, have the axis stony, but not fixed. They consist of two principal genera, but each admits of subdivision.

PENNATULA.

This genus have a common body, perfectly free, and susceptible of locomotion by the contractions of its fleshy part, and the joint action of all the polypi. The contractions and dilatations are produced by fibrous layers, which are embedded in the fleshy substance. The axis is a single stony column, and the polypi generally have eight toothed tentacula. Whatever may be their form, one extremity is always without polypi, and resembles the barrel of a feather—hence the name. Most of them can emit a bright phosphorescent light; and though their general habit be to swim freely in the water, some species fix themselves in the sand, or get entangled in the folds of submarine bodies; but they never form an adhesion.

Pennatula, properly so called, have the portion without polypi cylindrical and with a blunt point; and the other part furnished on both sides with laminæ of various length and breadth, which are supported by tough bristles; but these bristles are not articulated upon the stony axis. The polypi are situated between these laminæ. Several species are found in the Atlantic and Mediterranean. *Virgularia*, have the laminæ much shorter. *Scirpearia*, have the body slender, and the polypi detached and alternate. *Pavonaria*, are also slender, but the polypi are arranged in quincunx on one side only. *Renilla*, have the body short with filaments, and a kidney-shaped disc on one side, bearing the polypi. *Veretillum*, are cylindrical, but without any branches; and the axis is usually small and the polypi large. *Ombellularia*, have a very long stem with a tuft of polypi at the end.

There are many small and porous stony bodies found in a fossil state, and in the sea, which, if they were invested with a living integument and polypi, would rank very nearly with this tribe. They are *Ovolites*, *Lunulites*, *Orbulites*, and others.

ALCYONIUM,

Which, with *Spongia*, forms the fourth tribe, has the polypi with eight arms, and the intestines in a common mass with the ovaries. It is not, however, supported by a stony axis; but always fixed to the body; and when it is drawn out into trunks and branches, these present nothing internally but gelatinous matter. The covering is hard, and marked with furrows, into which the polypi retire.

A. digitatum, the Sea Hand, divided into short and thick branches, and *A. exos*, with the branches smaller, and of a fine red, are the most common in the European seas. Linnæus and his followers included with this genus the *Thethya*, which have the interior roughened by long spiral lines of silicious matter, which unite in an equally silicious nucleus. The crust, like that of the Sponges, presents two kinds of openings, one for admitting water, and another for ejecting it.

SPONGIA (Sponges),—

Are well known as fibrous marine bodies, whose only sentient portion appears to be a sort of thin gelatine, which soon dries off. No polypi have been observed in them; and our knowledge of their real nature is very obscure. All the analogies, however, point them out as being animal, and not vegetable. The forms which they assume are almost innumerable.

THE FIFTH CLASS OF THE RADIATA.

THE INFUSORIA.

It is usual to place at the close of the Animal Kingdom, these beings, which are so small as to be in general inscrutable by the naked eye; and which have been known only since the microscope brought, as it were, a new world within the scope of our observation. [Every increase of extent of magnifying power and clearness of view, which the successive improvements of the microscope have enabled us to obtain, has been rewarded by new discoveries in the numbers, the forms, and the organization of these minute animals. Farther improvements in the structure of the instrument, and the mode of using it, may enable the observers of a future age to obtain information relative to this part of the Animal Kingdom, of which we of the present age can form no adequate

idea. But, even in the present limited state of our information, this department of nature is a very extensive one, and requires the study of a whole lifetime to obtain even a moderate knowledge of all its branches.]

The greater part of the Infusoria have a gelatinous body, and a very simple organization; but some naturalists have included among them other animals, which are far more complex in their organization, and which agree with them only in the smallness of their size, and the habitats in which they are usually found:—these will constitute our first order; but we must retain the doubts, which are not yet cleared up, respecting their organization.

THE FIRST ORDER OF THE INFUSORIA.

ROTIFERA.

These are, as we have stated, distinguished by a more complicated organization. Their body is of an oval shape, and gelatinous, and we can observe that they have a mouth, a stomach, an intestine, and a vent near the foot. The body usually terminates in a sort of tail, variously formed; and it has on the fore part a very singular organ, variously divided into tubes with toothed edges, the teeth of which vibrate in various ways, and give the organ the appearance of one or more toothed wheels, revolving with greater or less rapidity. The apparently revolving organ does not appear to convey food to the mouth; and so it may be, in some way, connected with the function of respiration.

FURCULARIA,—

Or the Rotifera properly so called, have the body unarmed, and the tail composed of articulated portions, which enter into each other.

Trichocerca, have the rotatory organs a little less developed. *Vaginales*, are said to resemble the former, inclosed in a transparent membrane; but that is doubtful.

Tubicolaria, form for themselves little habitations of foreign substances, out of which the rotatory organs are protruded, in a manner similar to the tentacula of polypi. *Branchionus*, are distinguished by a sort of membranous shield on the back.

THE SECOND ORDER OF THE INFUSORIA.

HOMOGENEA.

The body of these shows no viscera, or other complex organization, and in many there is not even a vestige of a mouth.

The first tribe comprehends those which, with a gelatinous body, more or less contractile in several parts, has yet ciliæ, or some other simple external organs.

Urcolaria, have the shape of a horn, but with ciliæ. *Trichoda*, have a flat body, ciliated at one extremity. *Leucophora*, have ciliæ all round the body. *Kerona*, have the ciliæ like little horns. *Hiantopa*, have them prolonged in a sort of threads.

The second tribe have no external organ, except a tail.

Cercarea, have an oval body, with a thread-like termination. The seminal animalculæ, which have given occasion to so many whimsical hypotheses, belong to this genus.

Vibrio, have the body round, like a very minute bit of thread. The "Eels in paste and in vinegar," as they are called, belong to this genus.

Enchelis, have the body oblong, more soft, and less defined than that of Vibrio. There are various other forms.

Proteus, are so constantly changing their shape, that no definition or description of it can be given.

Monas, are, even under the microscope, mere points, which move with great rapidity, though they have no apparent organs of motion.

Volvox, are globular bodies, revolving on their axes, and containing more minute globes, each of which also, in all probability, contains a numerous embryo race.

FOURTH DIVISION.—THE RADIATA.

THE group of Radiata, as left by Cuvier, is a very heterogeneous one; for it includes, with the truly-radiated animals, others which have no affinity with them. The designation is only correctly applicable to the ECHINODERMATA, the ACALEPHÆ, and the POLYPI; all of which are characterized by a more or less regular disposition of similar parts round a common centre. In the last of these classes, there is a tendency to the production of compound structures, resembling those of plants, by a process of *gemmation* or budding; in these compound structures the radial symmetry would seem altogether lost, but it is always discoverable in the individual polypes, although not exhibited by the mass. It is to this group, that the term *Zoophyte* is properly restricted; since it is in this alone that the plant-like growth is exhibited. The Acalephæ occasionally increase, like Polypes, by gemmation; but the gemmæ become detached, and do not form a composite structure. In the Echinodermata, multiplication by gemmation has not yet been observed.

Even when thus restricted, however, the ***Radiated*** sub-kingdom will not include all the animals belonging to the Cuvierian classes of Echinodermata, Acalephæ, and Polypi; for there is a large and important section of the last of these divisions, which ought, as will be explained hereafter, to be rather associated with the Mollusca, forming the connecting link between Tunicata and Zoophytes.

The class of ENTOZOA for the most part consists of animals which should be regarded as degraded forms of *Articulata;* their form, structure, mode of progression, &c., being essentially worm-like. Other genera, however, especially those ranked under the family *Tremadotea*, would seem to be rather *Molluscan* in their character; the *Planariæ* especially approximating very closely in their form, structure, and habits, to certain degraded tribes of *Nudibranchiate Gasteropoda.* In fact, nothing but the general simplicity of organization prevalent amongst the Entozoa, and their community of habitation (to which, however, the *Planariæ*, whose habits resemble those of Leeches, constitute an exception) could have caused the union into one group of forms so heterogeneous.

The class of INFUSORIA is now divided into two groups, which agree in nothing but the minuteness of their size, and the similarity of their habitation. The first of these, the ROTIFERA, ought to be placed among the ARTICULATA. The second, the POLYGASTRICA, must be regarded as forming the lowest class of the Animal Kingdom, if, indeed, it should be admitted into it at all. As they present no approach to a radiated structure, they have no title to be ranked amongst the RADIATA, and must form a group altogether distinct.

CLASS ECHINODERMATA.

The classification of this group proposed by Cuvier partook of the imperfections that necessarily result from an insufficient acquaintance with the form and structure of the animals which it is desired to arrange. The great increase of our knowledge in this respect has led to a much truer appreciation of the value of the different groups, and of the characters according to which they should be subdivided. It is remarkable, however, that notwithstanding the close gradation by which one group passes into another, so that there can be no question as to their mutual affinity, it is extremely difficult, if not impossible, to give any simple definition which shall include the entire class; for even the characters that are most typical of particular groups disappear entirely in others. Thus the *prickles* or spines upon the surface, from which the class takes its name, are especially characteristic of the *Echinus* and its allies; they are less developed, but still recognizable, in the various *Asteroid* tribes; but they disappear altogether in the *Crinoideæ,* which constitute the lowest order of the class, and in the *Holothuridæ* and *Sipunculidæ*, which in many points of their organization are the highest. Again, the *skeleton*, whose peculiar structure will be presently described, is fully developed in the *Crinoideæ*, in the *Echinus*, and in *Star-fish;* but nothing more than a mere rudiment of it exists in the *Holothuridæ*, and it disappears altogether in the *Sipunculidæ*. The most universal character, perhaps, is the

presence of *cirrhi*, or tubular tendril-like suckers, capable of being projected from the surface; of these, a rudiment is to be traced in the existing representatives of the *Crinoideæ;* they are more fully developed in the *Star-fish;* attain their highest development in the *Echinus;* are less numerous and efficient in the *Holothuridæ;* and disappear in the *Sipunculidæ*, the softness and flexibility of whose worm-like bodies render them unnecessary for locomotion.

The minute structure of the skeleton is essentially the same throughout the group; whether it forms a branching stem with a more or less massive body as in the *Crinoideæ*, a complete globular shell as in the *Echinus*, or a regular series of detached plates as in the *Star-fish;* or is only represented by a few isolated patches of calcareous deposit as in the *Holothuria*. It is chiefly composed of carbonate of lime, the proportion of animal matter being very small; and the material forms a very regular net-work, with open spaces which communicate freely with each other. The skeleton is thus rendered very light, whilst at the same time it possesses very considerable firmness, each part supporting the rest and deriving support from it. In certain situations, where increased strength is required, it is derived from the interposition of solid ribs or pillars; this is the case, for example, in the spines of the Echinus, in which the solid ribs and the intervening net-work are arranged in patterns of great regularity and beauty. [See Dr. Carpenter on the Structure of Shells, &c., in Report of British Association for 1847.]

The classification that seems in most complete harmony with the characters of the group and with its principal varieties of form, is that of Professor E. Forbes [British Echinodermata], which is founded especially upon the organs of locomotion. He divides the entire class into six orders; to which a seventh must now be added, in order to comprehend some very remarkable extinct forms recently discovered.

I. CRINOIDEÆ. The existing forms included in this order are few; but it was extremely abundant in former periods of the earth's history, and its remains form no inconsiderable portion of the solid crust of the globe. The one of its representatives whose structure has been most completely investigated, is the *Comatula;* an animal which, at first sight, does not depart very widely from the type of the Star-fish, with which it was associated by Cuvier. But it differs from it in several important particulars. The digestive cavity is confined to the central disk, and has two orifices, a mouth and an anus. The arms arising from this disk are solid, being composed of the calcareous frame-work already described; but they are covered with a thick and soft integument, in the substance of which the ovaries are dispersed, forming many thousand distinct spots. The arms are five in number; but they speedily subdivide, each usually separating into four. To the central stem of each arm, ointed lateral appendages of a similar structure are attached; and these also are clothed with the fleshy integument, which extends on either side in a sort of fin-like expansion. By the simultaneous movement of the arms, and the stroke of these numerous *pinnæ*, or fin-like appendages, against the water, the *Comatula* swims through the ocean very much after the manner of a Medusa. Hence this order may be termed PINNIGRADA. Sometimes, however, the Comatula attaches itself to sea-weeds or other floating bodies; and employs its long arms in bringing food to its mouth. It is not always, however, so completely free in its movements; for it begins life in the attached condition of a true *Crinoid* animal, having a long slender stalk which proceeds from the side of the disk opposite to the mouth, and which terminates in an expanded suctorial disk whereby it is fixed on a solid basis. This stem is made up of the same kind of structure as the remainder of the skeleton, and is enclosed by the same irritable integuments, by the contraction of which the head may be made to turn in any direction. When arrived at their full growth, the disk and arms quit the stem, and pass the remaining term of their existence in a state of freedom. A trace of the original attachment, however, may still be detected on the disk. The *pinnæ* are not developed on the arms, until near the close of the period of attachment; and their membranous expansions are probably peculiar to the free-moving species of this order. The *Comatula* in its attached state has been described as the *Pentacrinus Europæus*. It is very minute, and has only been discovered hitherto in the Cove of Cork.

A much larger *Pentacrinus (P. Caput Medusæ)* has been found, however, in the West Indian seas; which probably passes its whole life in the attached condition, and is thus a truer representative of the vast assemblage of extinct Crinoids. The disk and arms are formed like those of the Comatula; the latter are very numerous, and are thickly set with jointed pinnæ. The stem is more than a foot long, and is composed of a large number of pieces similar to those of the arms. From this stem there arise, at regular intervals, several verticils of secondary arms, which do not subdivide and are destitute of lateral appendages. The ovaries are not so dispersed as in the Comatula; but they are still *external* to the central disk, being seated on the arms near their base. In some of the fossil species of *Pentacrinus*, which are especially abundant in the Lias formation, the subdivision and ramification of the arms is carried to a much greater extent than in either of the existing forms. The number of pieces in the skeleton thus becomes very large. In the *P. Briareus* it has been calculated that at least 100,000 exist, exclusively of the joints of the lateral appendages, which are probably more than 50,000 additional. The base of the stem of the recent *P. Caput Medusæ* has not yet been obtained, so that its mode of attachment to solid bodies has not yet been clearly made out; but from the circumstances under which fossil remains are sometimes met with, there is reason to believe that the animals of this genus were not permanently adherent to solid masses, but had the power of occasionally detaching themselves.

The *Pentacrinus*, however, must not be regarded as the true type of the Crinoid order, but rather as a link of transition which connects it with the higher forms of Echinodermata. For the bulk of the group is made up of the very numerous tribe of *Encrinites*, which seems to have been in many respects of lower organization, connecting the free Echinodermata with Zoophytes. The body and jointed stem exhibit a rounded instead of a pentagonal form; the latter is usually destitute of secondary arms; and the principal branches do not ramify with the same minuteness as those of many Pentacrini. The stalk seems to have been attached by a sort of spreading root, resembling that of many Corals; and we must therefore believe this tribe of Crinoideæ to have been entirely fixed. It contains a numerous series of forms; some of them almost resembling stalked *Echini*, whilst others in like manner seem to connect the order with the two following.

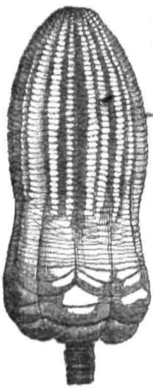

FIG 1.—ENCRINUS

II. OPHIURIDÆ. These Star-fishes are so named from the long serpent- or worm-like arms, which are appended to their round, depressed, urchin-like bodies. Although commonly associated with the true Star-fish, they are very distinct in their structure. The viscera are entirely confined to the central disk; and the arms are solid, like those of the Crinoideæ, being covered with a muscular integument, by which the joints are caused to move freely upon one another. On the other hand, they differ from the Crinoideæ in having but a single aperture to the digestive cavity; and also in the position of the ovaries, which are here situated *within* the disk, opening by separate orifices near the base of the arms. The arms are sometimes simple and undivided from their base to their free extremity, gradually tapering to a point, as in the ordinary *Ophiuræ;* whilst in *Euryale* they ramify minutely, dividing regularly into branches, which again subdivide so as to form a most complex series of appendages. The arms in this order very commonly bear scales or spines on their surface; and these appear to be of great use to the animals, their roughness giving to the arms a point of rest, from which they can push the body onward in any direction. Their movements are very active, in comparison with those of Star-fishes; and as they depend upon their spines for locomotion, they may be properly designated SPINIGRADA. Their *cirrhi* are not sufficiently developed to assist in locomotion; although those near the mouth are enlarged into tentacula, which seem to draw the food towards the orifice.

III. In the ASTERIADÆ, or true Star-fishes, the real *arms* altogether disappear; the *rays* being merely lobes of the body. In some instances there is scarcely any central disk, the body being almost entirely divided into rays; whilst in other cases there is but a slight division of the margin of the disk. The general structure of the *Asterias*, which is the type of the order, is described in the text (p. 639). The movement of these animals is sluggish, and is accomplished by means of the *cirrhi*, which form rows along the under side of the rays, and which serve as suckers for taking an attachment to any solid body. Hence the order may be designated CIRRHIGRADA. The development of the Star-fishes has been recently studied by Sars and others; and it appears that they are attached in their embryonic condition, by a sort of footstalk divided at its base into three lobes. This pedicle contracts, however, as the disk is developed, and is at last entirely withdrawn into the body of the animal. A trace of it still remains, however, in what has been termed the madreporiform tubercle.

IV. The order ECHINIDÆ corresponds with Cuvier's *Second Family of Pedicellata* (Text, p. 640). The type of the order is the genus *Echinus*, in which the shell is of globular form, having the oral orifice at one pole, and the anus at the other. The mouth is furnished with a complex dental apparatus (*c*, Fig. 2); and there is a regular intestinal tube, which makes two turns within the shell. The ovaries open by distinct orifices around the anus. The movement of these animals is partly accomplished by their spines, which are frequently very large and strong; and partly by their *cirrhi*, which are always capable of being extended further than the spines, and of taking an attachment to fixed bodies beyond. In this manner the globular shell may be drawn onwards in any direction; the movement being effected by the contraction of the tubes, but the body being supported upon the spines. From this compound mode of progression, the *Echinidæ* may be termed CIRRHI-SPINIGRADA. In

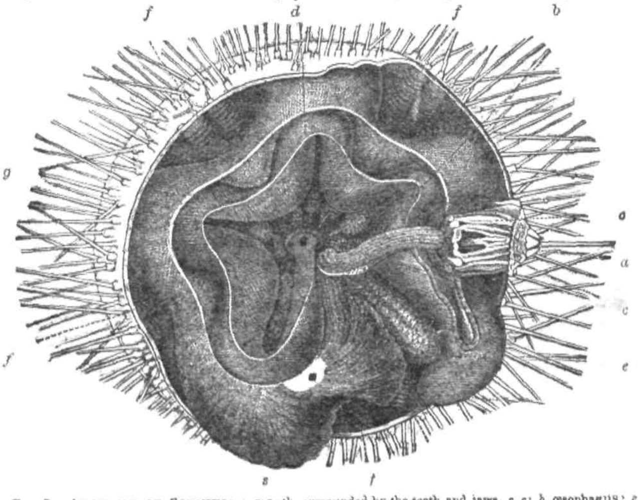

FIG. 2.—ANATOMY OF ECHINUS: *a*, mouth, surrounded by the teeth and jaws, *c*, *c*; *b*, œsophagus; *c*, stomach, or first portion of the intestine; *d*, intestinal tube; *e*, ovary; *f*, *f*, ambulacral vesicles; *g*, *g*, shell.

Clypeaster and *Scutella* we have an approach towards the *Asteriadæ;* the shell being more or less flattened, and divided at its margin so as to resemble the body of a Star-fish; whilst the anus leaves its central position on the upper surface, and approaches the mouth, which still retains its central position below. In the *Spatangus* and its allies, the radiated form is considerably departed from; the shell being oval instead of globular, and the mouth and anus being neither of them central. In fact the radiated arrangement shows a tendency to give place to a bi-lateral symmetry; and in this and some other particulars, the Spatangaceæ may be considered as leading towards the next group.

V. The order HOLOTHURIADÆ corresponds with Cuvier's *Third Family of Pedicellata* (p. 641). They combine, in a very curious manner, the radiated arrangement of the surface and oral appendages, which is characteristic of the Echinodermata, with the bi-lateral symmetry of the internal organs, which is characteristic of Articulated animals. Many of them, moreover, exhibit indications of an obscure transverse division of the soft body into segments, as in the *Annelida.* The movement of the body is partly effected by the *cirrhi,* and in part by the contraction of the integuments in the manner of a worm; so that they may be designated CIRRHI-VERMIGRADA. The cirrhi are not always developed equally on all sides of the body, being sometimes confined to one side on which the animal creeps; so that in this position it presents, as it were, a back and a belly. It is a very extraordinary fact in regard to these animals, that, when they are irritated, the whole of the viscera are frequently discharged from the interior, the body remaining as an empty sac; and yet that, after a time, the whole of the complex digestive, circulating, and respiratory apparatus is regenerated.

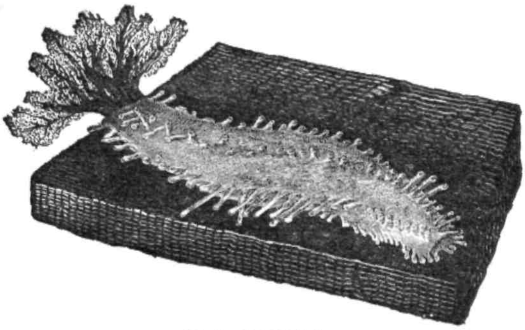
FIG. 3.—HOLOTHURIA.

VI. In the order SIPUNCULIDÆ, which corresponds with Cuvier's Second Order *Apoda,* the radiated arrangement still more completely gives place to the annular. In their external appearance they are worms; they have no cirrhi; and their progression is entirely accomplished, like that of worms, by the contraction of their integuments; whence they may be designated VERMIGRADA. In the general structure of their internal organs, however, they bear a much closer resemblance to the Holothuriadæ than to Annulose animals, and must therefore be properly regarded as belonging to the class Echinodermata, which it links with the Articulate series.

The recent discovery of an entirely new series of forms of Echinodermata, which abounded in the early ages of the earth's history, but which seems to have become entirely extinct before the Pentacrinites were called into existence, has rendered it necessary to institute a new order, the CYSTIDEÆ, the place of which seems to be intermediate between the *Crinoideæ,* the *Echinidæ,* the *Asteriadæ,* and the *Ophiuridæ;* for it combines within itself, in a most remarkable manner, some of the distinctive characters of each of these groups. "The Cystideæ are more or less spherical bodies covered with polygonal plates, varying in number according to the genus, closely fitting together so as to invest the entire surface with a compact coat of mail, except at four points, viz. inferiorly, where the body unites with a stem; centrally, or above the centre on one side, where there is an opening closed by valves, supposed with good reason to be the orifice of the reproductive system; and superiorly, where the mouth is found, usually if not always with a small perforation, supposed to be a vent, alongside of it. These parts, viz. the plates investing the body, the three orifices (for the fourth perforation, that of the base, is continuous with the canal of the stem where the latter is well developed), and probably the stem, are common to all *Cystideæ.* There are other parts, apparently of great consequence in the organization of the animal, which are common only to certain members of the order. These are the brachial appendages (arms and tentacula) and certain curious organs or appendages connected with the plates, to which the name of *pectinated rhombs* may be appropriately given." [Professor E. Forbes on the *British Cystideæ,* in the Memoirs of the Geological Survey of Great Britain, Vol. II.] Thus in the attachment of the body by a stem, the *Cystideæ* resemble the *Crinoideæ;* and some of the aberrant forms of these two orders come into very close approximation with each other. In the complete enclosure of the body within a shell composed of polygonal plates, they correspond with the *Echinidæ.* In the division of the body of certain genera into lobes, the approach the *Asteriadæ;* and the arms, where they are present, are more nearly allied, as regards their structure and origin, to those of the *Ophiuridæ* than to those of the *Crinoideæ.*

The *Cystideæ* and the *Crinoideæ* seem to have been abundant in the earliest age of organic life on the earth, namely, the *Palæozoic* period; whilst the remains of the more highly organized *Star-fish* and *Echini* are but rarely found in the rocks of that series. During the *Secondary* period, on the other hand, we find the latter gradually becoming more numerous, and their forms more varied; the lower forms of Crinoideæ give place to the higher, and these in their turn all but disappear; whilst the Cystideæ seem to have become altogether extinct very early in that series. In the *Tertiary* period we find a close approximation to the existing distribution of Echinodermata.

CLASS ACALEPHÆ.

The classification of this group proposed by Cuvier was founded upon a very imperfect acquaintance with the animals it includes; and it is now altogether abandoned. Much remains to be known, however, with respect to the internal structure of many of the tribes with whose external forms we are familiar; and it is probable that no classification yet proposed will remain without considerable modification from future discoveries. That which is at present most generally received is based on the mode of locomotion peculiar to the different tribes; according to which the class is divided into the four orders, PULMOGRADA, CILIOGRADA, CIRRHIGRADA, and PHYSOGRADA.

I. The order PULMOGRADA, or DISCOPHORÆ, including all the ordinary *Medusæ*, is characterized by the regular discoidal or circular form of the animals composing it. The body is of gelatinous texture, without any internal solid skeleton; the stomach is placed under the centre of the disk, and usually opens by a single central mouth; round the stomach are placed the ovaries, opening by separate apertures; the margin of the disk is usually furnished with *cirrhi* or tendril-like appendages, but these are not extensible nor contractile; whilst from the centre of the disk there usually proceeds another set of appendages, which sometimes take the form of separate tentacula (as in the accompanying figure), but are frequently united into a sort of proboscis which forms a prolongation of the mouth. The body moves through the water by a sort of flapping movement of the disk, which is furnished with muscular fibres. This order is again subdivided by Professor E. Forbes (On the British Naked-eyed Medusæ) into two sub-orders, the *Steganopthalmata*, or hooded-eyed, and the *Gymnopthalmata*, or naked-eyed; the former consisting of those which have the *ocelli* or eye-like bodies of their margin protected by membranous hoods or coverings more or less complicated, whilst the latter have the *ocelli* unprotected. This character may seem trivial; but it serves as the indication of a very important difference of internal structure; for whilst the first of these divisions possesses a much ramified and anastomosing system of vessels spreading over the surface of the disk, the second has a very simple vascular apparatus, the circulating canals proceeding to the margin either altogether unbranched, or, if divided, not anastomosing with one another. In the first of these families are included all the larger Medusæ, such as those belonging to the genera *Aurelia*, *Pelagia*, *Chrysaora*, *Rhizostoma*, *Cassiopea*, and *Cyanæa*; whilst the latter comprehends numerous smaller and more delicate forms, such as those belonging to the genera *Occania*, *Æquorea*, *Geryonia*, and *Thaumantias*.

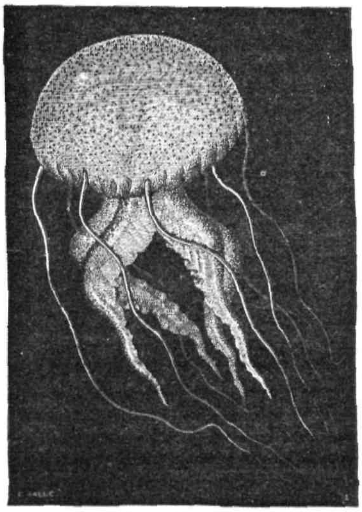

FIG. 4.—PELAGIA.

II. The form of the body in the CILIOGRADA is extremely various. Thus in the *Cydippe* (formerly called *Beröe*) it is nearly globular; whilst in the *Cestum Veneris* it is a long flat riband. The character of the order, however, is derived from the fact that all the animals composing it are propelled through the water, not by the movement of one part of their bodies upon another, but by the vibration of the cilia with which certain parts of their surface are covered. In *Cydippe* the cilia form eight bands, which extend like meridian-lines from pole to pole of the globular body. In *Cestum Veneris*, both edges of the long riband-shaped body are fringed with these curious filaments. Notwithstanding the wide difference in form between the two genera just named, they are connected together by intermediate links. Thus in *Callianira*, the globular body is extended laterally, so as to form wing-like appendages on either side; in other genera these appendages are still more extended, and the central globe is lost in them; until at last the flat riband-like form of *Cestum Veneris* is attained. The position of the alimentary canal, which has here two orifices, is the same throughout this series; for whilst in *Cydippe* it runs from pole to pole of the globe (Fig. 5), in *Cestum Veneris* it is equally short and straight, running *across* the body at the middle of its length. In no animal of this order is there anything like an internal skeleton, the whole body being gelatinous. In *Cydippe*, however, the bands upon which the cilia are seated are of firmer texture than the rest. Many of these animals are very active in their movements, contrasting strongly with the sluggish Pulmograda. The *Cydippe pileus*, a species very abundant on many parts of the British coast, is particularly energetic. It is provided with two long tendril-like filaments, arising from the bottom of two cavities in the posterior part of the body; and each of them is furnished with lateral branches. These filaments can be entirely retracted within the two cavities of the body, so that

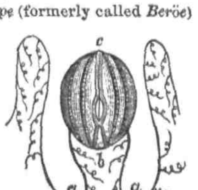

FIG. 5. CYDIPPE; *a*, *a*, tentacula; *b*, mouth; *c*, terminal of intestine.

they are not visible externally; and are put forth at the will of the animal, the main filaments being first ejected, apparently by the contraction of the cavity, and the lateral tendrils then uncoiling.

III. The CIRRHIGRADA form a small group, distinguished by the presence of a cartilaginous internal skeleton, and by the possession of very numerous contractile *cirrhi* or tentacula surrounding the mouth, by the movements of which the animal is slowly propelled through the water. In *Porpita*, the body forms a circular disk, and the cartilaginous skeleton is flat. In *Velella* the body is oval, and the cartilaginous disk has a vertical plate rising from it, which acts as a sail when these beautiful little animals are floating on the surface of the water. The stomach in these animals is a simple flask-like cavity, placed under the centre of the disk, and having but one orifice, which is furnished with a sort of proboscis.

IV. The order PHYSOGRADA corresponds with the *Hydrostatica* of Cuvier. In this group we lose altogether the *radiated* form, but have a *lateral* symmetry; the two halves of the body, divided by a plane passing from one end to the other, being similar to each other. The anatomy of the *Physalia* has been carefully investigated of late, and has been proved to be in some respects different from the description given by Cuvier. There is a proper digestive cavity, entirely distinct from the air-sac, and situated underneath one of its extremities; this has no single mouth, but receives its supplies of aliment through a number of flask-shaped appendages which hang down beneath, each having an orifice at its extremity, surrounded by a sort of sucker. These are entirely distinct from the long contractile tentacula, which are employed for grasping prey, at the same time paralyzing it by means of their peculiar stinging power. These tentacula can be drawn up to within half-an-inch of the air-bladder, and may be then suddenly shot forth to a length of eighteen or twenty feet. In this manner they attack small fishes, even at a considerable distance, and then probably draw them within reach of the suctorial appendages. It is not peculiar to this animal to have the single mouth replaced by numerous minute orifices; for the same is the case with the *Rhizostoma* among the Pulmograda.

FIG. 6.—PHYSALIA; *a c*, orifices o the air-sac; *b*, membraneous crest.

A most unexpected connection has been recently discovered between the *Pulmograde Acalephæ*, and the *Hydraform Polypes;* which shows that the two classes, however dissimilar in their aspect and structure, are very closely united to each other, and should even be included in the same group. It has been ascertained that many species of the *Pulmograde Acalephæ*, both *hooded-eyed* and *naked-eyed*—and therefore, probably, the whole order—begin life in a true *polypoid* state, and only acquire the Medusan character after a series of very remarkable metamorphoses. On the other hand it would appear that many of the animals known as *Hydraform Polypes* produce, by gemmation, bodies which are in all respects true Medusæ, and which are charged with the production of ova, from which a new generation of Polypes shall arise. The latter part of this interesting series of phenomena will be described under the head of Polypifera; of the development of the *Medusæ*, as made known by the observations of Sars, Siebold, Steenstrup, and Sir J. G. Dalyell, a brief account will now be given.

From the egg of the *Medusæ* is first produced a minute disk, very much resembling an infusory animalcule, and moving through the water by the action of the cilia with which its body is fringed (Fig. 7, *a*); at one extremity of the body is a minute depression, by which it afterwards becomes attached. After about three days, the embryo attaches itself to some fixed object (as at *b*); the form of the body begins to change from the cylindrical to the club-shaped (*c*, *d*); and the cilia of its surface disappear. The upper end is now flattened; the position of the mouth is marked out by a depression in its centre, which is surrounded by an elevated margin; and four indistinct tubercles, the rudiments of tentacula, are seen around it. (This is shown at *e*, which represents an individual in the condition of *d*, but seen from above.) The tubercles gradually elongate into tentacula; a true mouth is seen in the centre, and tentacula spring up between the preceding; and the body gradually assumes the form of the *Hydra*. These changes are represented in Figs. *f*, *g*, *h*, *i*, *j*, and *k*; Fig. *g*, being a view taken from above of the animal the stage *f*; and Fig. *k* being a corresponding view of the stage *j*. Now in this condition, the animal is in every essential particular, a true *Polype;* and has been repeatedly so described. It remains attached by its base to one spot, draws its food into its mouth by means of its arms, and these contract when the stomach is distended, and cannot then be irritated to movement. Not only does it live as a Polype, but it also reproduces itself as a polype; for polype-buds are not unfrequently seen to issue from its sides (Fig. 7, *l*); these become detached and form new individuals, just as in the Hydra. Thus from a single individual, a whole colony may be produced; and these may all continue in the polypoid condition for many months, or even years. But under some peculiar circumstances, whose nature has not yet been determined, an entirely new series of changes at last takes place. The body assumes a more elongated cylindrical form

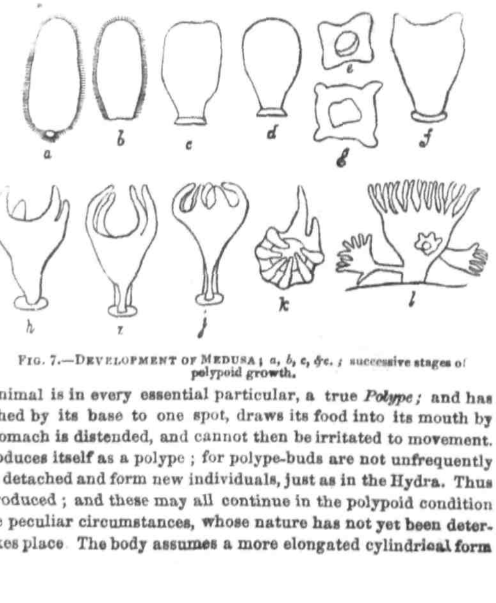

FIG. 7.—DEVELOPMENT OF MEDUSA; *a*, *b*, *c*, *&c.*; successive stages of polypoid growth.

than it previously possessed ; and a constriction or indentation is seen around this cylinder, just below the ring that surrounds the mouth and gives origin to the tentacula (Fig. 8, *a*.) Similar constrictions are soon repeated around the lower parts of the cylinder, so as to give to the whole somewhat the appearance of a rouleau of coins (*b*). Still, however, a sort of fleshy bulb,—somewhat in the form of the original polype, is left at the base. The number of the circles is indefinite, and all are not formed at once ; new constrictions appearing below, after the upper portions have been detached. As many as twenty-seven disks have thus been progressively separated in one animal. The constrictions then gradually deepen, so as almost to divide the cylinder into a pile of distinct saucer-like bodies ; the divisions being most complete above, and the upper disks often presenting a considerable increase in their diameter. As the disks thus become more distinct from each other, and of enlarged dimensions, their edges are no longer plain but lobed (*c*) ; and the lobes soon present the clefts and ocelli characteristic of the detached Medusæ. Up to this period the tentacula of the original polype surmounted the highest of the disks ; and a general contraction and relaxation of the whole cylinder, causing the intervals between the disks to be diminished or increased, might be occasionally seen to take place. But before the detachment of the topmost disk, the circle of tentacula by which it was originally surrounded disappears,—in what precise manner has not been ascertained ; and meanwhile a new circle of tentacula is developed upon the summit of the bulb that remains below the pile of disks. At last, a sort of convulsive movement takes place in the topmost and largest disk, which becomes detached and swims freely away ; and the same series of changes takes place from above downwards, until the whole pile of disks is detached and converted into free-swimming Medusæ. (At *d* is shown the lower part of the compound structure, the disks of which have nearly separated from each other.) But *the original polypoid body still remains*, and may return to its polypoid life and gemmiparous production, becoming the progenitor of a new colony of hydræ, each one of which may develope in its turn a pile of medusa-disks. This last fact, which we owe to the patient and long-continued observations of Sir J. G. Dalyell, is of fundamental importance ; as proving that the curious process now described is not, as maintained by some, a *subdivision* of the polypoid body into medusa-disks ; but that it is a *gemmiparous* production of Medusa-buds from the polypoid body, of the same kind as that of which examples will hereafter be described under the head of Hydraform Polypes ; save that the buds are here developed between the body and the tentacular circle, instead of being protruded, as in the latter case, from the sides of the body.

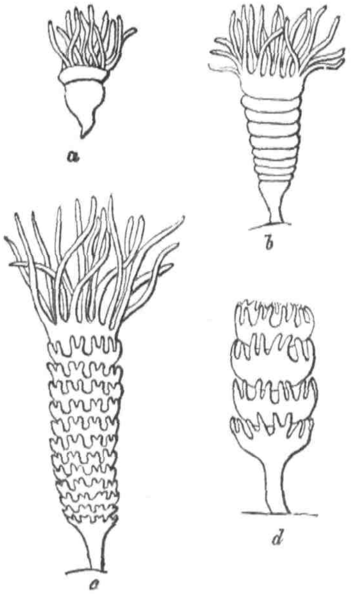

FIG. 8.—PRODUCTION OF MEDUSA—BUDS FROM POLYPE BODIES; *a*, *b*, *c*, *d*, successive stages

The disks thus detached, although *Medusan* in their character, are far from possessing the form or structure they are ultimately to present. This is attained during the progress of their growth, by a difference in the rate of development of different parts, rather than by an entire metamorphosis. The segments or lobes of the margin increase very little in size, whilst the intervals between them gradually fill up ; tubular prolongations of the stomach extend themselves over the disk, and its border becomes furnished with long pendent prehensile tentacles. The mouth, which even in the youngest detached animal allows of being greatly extended and protruded, is quadrangular, and presents four extensible angles. These angles grow more rapidly than the four-sided oral tube or proboscis ; so that, in the more advanced animals, the mouth appears as if it had split during the growth into four lobes ; and the minute serratures which appear on the edges of these are the commencement of the lobes and fringes which are observed on the tentacula of the adult animal. The reproductive organs are at last evolved, the sexes being kept distinct ; and by their agency ova are produced, from which the animalcular embryo is developed as before into a polypoid body.

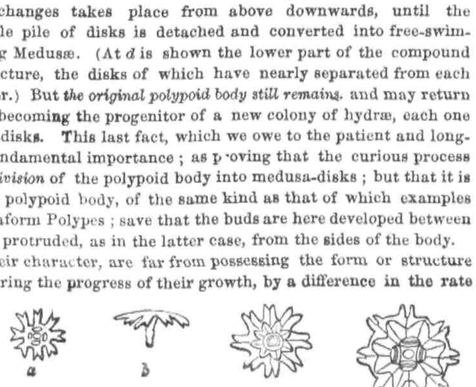

FIG. 9.—DEVELOPMENT OF MEDUSA—DISKS; *a*, *b*, *c*, *d*, *e*, *f*, successive stages

The propagation of the *Medusæ* is not only effected by ova, but also in some instances by gemmation ; another indication of their close alliance to Zoophytes. This has been observed by Sars in *Cytæis octopunctata* (*Lizzia* of Professor E. Forbes, op. cit.), and by Professor E. Forbes in two species of *Sarsia*. In the former case, the gemmæ are produced from the external wall of the stomach ; in *Sarsia gemmifera*, they grow from the lower part of the peduncle, or proboscis-like prolongation of the mouth ; and in *Sarsia prolifera* they spring from the bases of the tentacula that hang from the margin of the disk.

CLASS POLYPI.

OF this class, now more commonly termed POLYPIFERA, much more is now known than was known to Cuvier; and his classification has altogether given place to one in which the primary characters are drawn from the structure of the *animal*, that derived from the compound mass or *polypidom* being of secondary importance. The separation of the *Carnosi* or *Actiniform* polypes from the *Gelatinosi* or *Hydraform* polypes, was, as we shall see, quite correct; but, on the other hand, the separation of the solitary genera from the compound forms of the same groups was altogether erroneous. Thus among the *Coralliferi* of Cuvier, the greater part of the first family is composed of Hydraform polypes; the second is made up of one genus (*Cellularia*) which is not a Zoophyte at all, but a Molluscan, and of another (*Corallina*) which is now well ascertained to be of vegetable character; whilst the third is a heterogenous assemblage of Molluscans, with Actiniform and Alcyonian Polypes, and Sponges.

The primary division of the Cuvierian Polypifera is now generally admitted to be into BRYOZOA and ANTHOZOA; the former being truly *Molluscans*, and properly forming part of the class TUNICATA; whilst the latter are true *Radiated* animals. To the latter alone, therefore, ought the name of Zoophytes to be restricted. An outline view of the structure and classification of each group will now be given.

BRYOZOA.

IF we imagine the minute tentacula which fringe the oral orifice of many *Ascidians* to be greatly prolonged and clothed with cilia, whilst on the other hand, the respiratory chamber or dilated pharynx is contracted, we shall have the likeness in its most important characters, of the animal of the *Flustra*, *Bowerbankia*, or any other Bryozoon. It is not surprising that, until the structure of these animals had been investigated, the stony and horny fabrics which they form should have been regarded as polypidoms. And even since the wide differences in conformation between the Bryozoa and the Anthozoa have been made known, the former as well as the latter have been frequently ranked among the Polypifera. The discovery of the gemmiparous development of the true Tunicata, however, has removed one of the great boundaries that seemed to divide them from the Bryozoa; whilst, on the other hand, the existence of forms among the latter that present a very near approach to the former, and more especially the discovery that their nervous system is not formed upon the radiated type, but consists of a single ganglion placed between the two orifices, as in the Tunicata, have led to their entire detachment from the class Polypifera, and their removal to the Molluscan series.

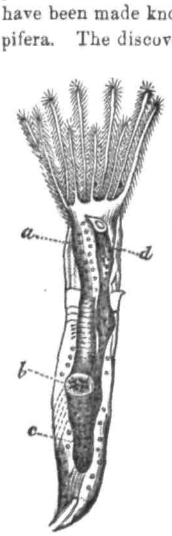

FIG. 10.—BOWERBANKIA; *a*, œsophagus; *b*, gizzard; *c*, stomach; *d*, orifice of intestine.

The grounds of this separation, and the relations of the Bryozoa to the Tunicata and Polypifera respectively, will be better understood when the structure of the animals has been examined. To this, therefore, we now proceed, taking as our type a very common British species, the *Bowerbankia densa*, in which, from the isolation and transparency of the shell or sheath, the internal arrangement can be very distinctly seen. The animal of the *Bowerbankia*, when the tentacula are fully expanded, is about half an inch in length, and the cell does not nearly extend to the base of the tentacula; the animal can be retracted, however, so as to be completely protected by the cell, the edges of which are drawn in so as to close the aperture. The cells of the *Bowerbankia* are horny in their texture, and arise separately from a sort of stolon or creeping stem, very much after the manner of the separate individuals of the *Porophora* (see Appendix to Mollusca, Fig. 7): in many other genera, however, a solid calcareous fabric is produced, in which the cells are imbedded; whilst in other instances, again, this fabric is soft in its texture, being sometimes gelatinous as in the compound Ascidians, in other instances spongy as in the Alcyonian Polypes. The tentacula, of which there are ten in the *Bowerbankia*, but a greater number in many other genera, are always furnished with cilia; by this character these animals are

at once distinguished from the minute Hydraform Polypes which most resemble them, the arms of the latter being never furnished with these appendages. The mouth leads to a wide funnel-shaped tube, the pharynx, which soon contracts into a narrower canal or œsophagus, that terminates at its lower end in the digestive cavity. The first part of this is an organ which seems closely to resemble a *gizzard;* it is a globular form, and has two dark spots upon its sides, from which radiating lines are seen; and these seem to be composed of muscular fibres, whose office it is to effect the trituration of the food, by means of teeth projecting from the inner wall of the cavity. The gizzard opens at its lower end into a larger bag, which is the true digestive stomach. Its walls are thickly studded with spots of a rich brown colour; these appear to be caused by minute follicles or sacs opening from its cavity and secreting bile, thus constituting the most rudimentary form of liver. From the upper part of the stomach, and by the side of the entrance from the gizzard, arises the intestine, the entrance to which is surrounded by vibratile cilia. This passes up as a straight tube by the side of the œsophagus, and terminates by a proper anal aperture outside the circle of tentacula. The whole of this complex digestive apparatus floats freely within the general cavity formed by the membrane that lines the cell; the intervening space being occupied by a clear fluid, and by the muscles which project the animal from the cell, and which retract it within that envelope. This space communicates with the cavity of the stem, and also with the interior of the tentacula. There would appear to be no definite circulating system, neither heart nor blood-vessels being discoverable. The propagation of these animals takes place in two ways—by *gemmæ* or buds—and by *ova* or eggs. The buds are developed in Bowerbankia, and in other genera whose cells arise separately from a stolon, from the stem itself; but in those in which the cells are in contact with each other, and there is no common stem, as in the *Flustra*, the cells bud off from each other.

Now if we scrutinize these characters, we shall see that the greater number of them are rather Molluscan than Zoophytic. In the first place, all the true Polypes use their arms to grasp their food and to convey it to the mouth, and the arms are destitute of cilia. On the other hand, in the Ascidians and all other Acephalous Mollusca, the nutritive matter is drawn in by a ciliary current, which also serves to aerate the fluids. Thus, although the arms of the Bryozoa very commonly present a circular arrangement, they may be considered as representing, in their relation to the economy of the animal, the ciliated branchial sac of the Ascidian. But they do not by any means constantly present this radial symmetry. Thus in the *Plumatella*, a beautiful freshwater genus belonging to the order HIPPOCREPIA, the ciliated arms are set upon two lobes or projections, one on either side of the mouth. The structure of the digestive apparatus is decidedly Molluscan. In no true Polype is there a separate intestine or anal orifice; and the existence of a gizzard-like organ, and of the rudiment of a liver (exactly resembling that found in the lowest Tunicata) are also characters of elevation. The most important of all the single characters furnished by the anatomy of these animals is their nervous system; which, as already pointed out, is decidedly Molluscan. The absence of a heart and distinct circulating system is, it is true, a Zoophytic character; but we have found that, even in the true Tunicata, the circulation possessed a want of constancy which indicated a tendency towards degradation. The propagation by gemmation, although formerly supposed to be a character exclusively Zoophytic, is now known to belong also to the Tunicated Mollusca; from this, therefore, no argument can be drawn in favour of the Zoophytic nature of these animals. And although many of their compound fabrics have a stony density, and closely resemble the solid polypidoms of the Anthozoa, yet in others, especially among the freshwater species, we find a very close resemblance to the gelatinous bed or leathery crust in which the compound Ascidians are lodged. And if we imagined calcarous matter to be deposited in this bed or crust, we should have a strong fabric resembling that of many Bryozoa. In their power of projecting their bodies from their cells, the Bryozoa must be admitted to resemble Polypes rather than Tunicata; but this is a character of no particular importance; and some approaches to it are seen among the compound Ascidians.

The following is the arrangement of the Bryozoa given by Dr. Johnston (British Zoophytes, second edition). It must be borne in mind that the terms *polype* and *polypidom* are not properly applicable to these animals and their compound fabric.

ORDER I.—INFUNDIBULATA.

Natives of the sea. Polypes compound, the mouth surrounded with ciliated, filiform, retractile tentacula, which form an uninterrupted circle; ova ciliated.

Section A. Polypidoms calcareous; the cells tubular with a round terminal aperture uncovered by an operculum.

Family 1. *Tubuliporidæ.* Polypidoms multiform, massive or crustaceous.

Family 2. *Crisiadæ.* Polypidoms confervoid, jointed.

Section B. Polypidoms calcareous or membrano-calcareous, multiform, composed of oblong or oviform cells, whose subterminal aperture is closed by a membranous fold or operculum.

Family 3. *Eucratiadæ.* Polypidoms branched in a confervoid manner; cells oblong; no ovarian capsules.

Family 4. *Celleporidæ.* Polypidoms massive or crustaceous, composed of ovate cells in juxta-position, the aperture terminal, often furnished with a globular capsule.

Family 5. *Escharidæ.* Polypidoms multiform, composed of oblong sub-quadrangular cells, disposed in a semi-alternating series; the cells conjunct, horizontal to the plane of axis, with a subterminal or lateral aperture, usually covered with an ovarian capsule.

Section C. Polypidoms sponge-like, fleshy, polymorphous; the cells irregular in disposition, immersed, with a contractile aperture; no external ovarian capsules.

Family 6. *Halcyonellea.*

Section D. Polypidoms confervoid, horny, fistular; the polype-cells free.

Family 7. *Vesiculariadæ.* Body of the Polype separate from the parietes of the cell, which is deciduous.

Family 8. *Pedicellinæ.* Body of the Polype aduate to the cell.

ORDER II.—HIPPOCREPIA.

Lacustrine or natives of fresh water. Polypes compound, the mouth surrounded with ciliated retractile tentacula, interrupted or depressed on one side, so as to assume a crescentic or horse-shoe form; ova unciliated.

Section A. Polype-mass floating.

Family 1. *Cristatellidæ.*

Section B. Polype-mass rooted.

Family 2. *Plumatellidæ.* Polype-mass massive or confervoid; inarticulate.

Family 3. *Paludicellidæ.* Polype-mass confervoid, jointed.

It would seem that with the Bryozoa should be associated the very curious group of *Foraminifera,* placed by Cuvier among the Cephalopoda. The structure of the animals has not been yet made out, however, with sufficient precision to enable their exact position in the zoological scale to be determined.

The *Bryozoa* are diffused through all latitudes, and they appear to have existed at a very early period of the earth's history; many of the (so-called) corals of the palæozoic series belonging to this division. Their massive stony structures would seem to have been formerly more abundant in our own seas than they are at present; whole reefs having been produced by their growth, as they are in the tropical seas by the growth of the existing corals of the *lamelliform* kind presently to be described.

ANTHOZOA.

The Anthozoa, or true *Polpyi,* are distinguished from the preceding by the perfect radial symmetry of their internal structure, as well as of their external conformation. Their nervous system has not been clearly made out; but there can be no doubt that, if it really exist in a distinct condition, it forms a ring surrounding the mouth. The digestive cavity has no intestine nor anal orifice; but in many compound Polypefera it is prolonged into the interior of the mass, and joins a system of canals by which the stomachs of the several Polypes are connected with each other. The tentacula are never clothed with cilia. The class may be divided into the orders HYDROIDA, or *Hydraform* Polypes; HELIANTHOIDA, or *Actiniform* Polypes; and ASTEROIDA, or *Alcyonian* Polypes. By some, however, the two latter orders are regarded as forming one group, equivalent to the Hydroida.

FIG. 11.—HYDRA; a, mouth.

ORDER I.—HYDROIDA.

This order is made up of simple and composite structures, of which the *Hydra* is the type (see text, p. 654). It is distinguished by the absence of any cavity around the stomach; the wall of the digestive cavity and the external integument of the body being merely the inner and outer layers of the same membrane. The mouth is surrounded by slender tentacula, which are beset with little points that seem to have a stinging power; and by the agency of these arms the food is grasped and conveyed into the stomach. They are nearly all marine, and are found in all latitudes. In some of the solitary and nearly all the composite species, the external integument possesses a horny consistence; and thus are formed more or less perfect polype-cells, within which the body is lodged. The mode in which these structures are increased by gemmation frequently gives them a very plant-like aspect. The *Hydra* produces buds, which at first project from the side

of its body as little knobs or protuberances, but gradually acquire the form and structure of the original; and these, when they have arrived at maturity and are able to maintain their own existence, become detached and live independently. Before this separation takes place, however, but after their stomach and tentacula are fully developed, the digestive cavities of the young Hydræ (of which several may exist at once upon one stock) are connected with that of the parent by an aperture in their footstalks; and fluids can pass readily from one to the other. Now this is, in fact, the essential condition of such a compound structure as the one represented in Fig. 12; for all the polypes in such a structure have been in reality produced by gemmation from a single individual; and their digestive cavities are united by tubes which proceed from the base of each, along the stalk, to communicate with the cavity of the central stem. There is this peculiarity, however, in the compound polypes of this order—viz. that the vitality seems rather to exist in the stem and branches than in the polypes seated upon them; for the polypes not unfrequently die, are cast off, and then renewed, like the leaves of a tree. A circulation of fluid may be seen to take place within the stem and branches of many of the compound Hydroida. Like that of the *Ascidians*, it is reversed at intervals; the flow being sometimes very rapid, then slackening and stopping, and then recommencing in the opposite direction, sometimes after an interval, sometimes immediately.

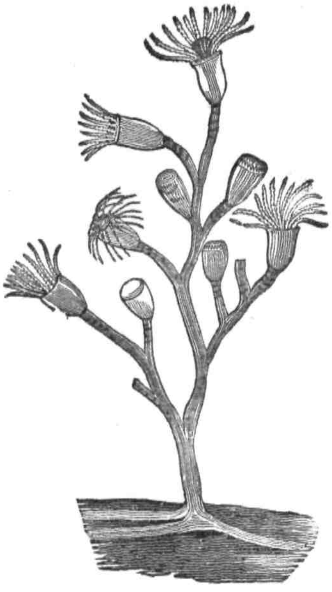

FIG. 12.—CAMPANULARIA.

The study of the reproduction of the Hydroida has disclosed some very curious facts. Besides propagating itself by buds, in the manner just described, the *Hydra*, towards the approach of winter, forms ovisacs in the membranous substance of its body near the foot; whilst spermatic vesicles are formed in like manner near the oral extremity. These discharge their contents—ova and spermatozoa—at the same time; and from the fertilized ova it is probable that a new generation of Hydræ is developed. In the compound Hydroida, however, we do not find either eggs or gemmæ produced from the bodies of the individual polypes. For the extension of the parent structure, new polype-cells and polypes are evolved from the stem and branches; whilst for the production of an entirely new generation, we find a very distinct and most remarkable provision. In many of the solitary or slightly branching genera of the marine Hydroida, belonging to the family *Tubularidæ*, the body of the polype produces buds altogether unlike itself; these buds are, in fact, true *Medusæ*, and have been described as such after their detachment and their attainment of their complete form. It is by the *Medusæ* which freely swim through the water, and which thus go to form new colonies elsewhere, that the true *ova* are produced, which are developed at first into polypes; these polypes evolve Medusa-buds; and from the mature Medusæ, ova are again produced, from which a new generation arises, to go through the same curious series of phenomena. There is little difficulty in perceiving here a close analogy with the history of vegetable development. The seed and the egg are essentially the same thing; from it spring in the one case a stem and leaves, in the other a stem and polypes; these may extend by gemmation to any degree, producing new leaves or new polypes; but after a time a different set of buds appears, the flower-buds and the Medusæ, containing distinct sexual organs, by which seeds and ova are again generated. The only difference that even *seems* essential, lies in the *detachment* of the Medusa-buds; but this is only that they may possess locomotive powers which shall carry them to a distance, in order that the ova may be widely scattered through the ocean.

In other Compound Hydroida, however, there is a distinct apparatus for the development of the Medusa-buds. This consists of a large cell or capsule, which was formerly designated as an "ovarian vesicle," being supposed to produce ova from which new polypes arise. But it is now known that in many cases, at least, the bodies really generated in them are *Medusa-buds*, which become detached (sometimes in a very immature form), and swim forth to deposit their ova, from which a new generation of polypes will arise, in some distant spot. This is certainly the case with the *Campanularidæ;* but whether the "gemmules" which issue from the ovarian vesicles of the *Sertularidæ* are of the same nature, has not yet been ascertained.

Thus we have seen that the Hydraform Polypes are so closely connected with the Pulmograde Medusæ, that they cannot be justly separated from each other. For whilst the animals best known to us as *Medusæ* can be shown to pass the early part of their lives in the *Polypoid* condition, the animals best known to us as *Hydraform Polypes* are sexually propagated by *Medusan* bodies springing from them by gemmation.

The following is Dr. Johnston's classification of this order:—

Section A.—Ovisacs or bulbules naked, bud-like, pullulating from the bases of the tentacula.

Family 1. *Corynidæ.* Polypes naked, or with only a rudimentary polypidom.

Family 2. *Tubularidæ.* Polypidom fistular; the tentacula whorled.

Section B. Ovisacs in the form of horny capsules or vesicles scattered on the polypidoms, and deciduous.

Family 3. *Sertularidæ.* Cells of the polypes sessile.

Family 5. *Campanularidæ.* Polype-cells on ringed stalks.

Section C. Polypes propagating by buds and ova, which develope themselves on and in the body of the parent.

Family 5. *Hydraidæ.*

Order II.—HELIANTHOIDA.

This order derives its designation from the resemblance borne by the polypes it includes to a sun-flower or other composite blossom. The common *Actinia* may be taken as its type; and all the animals which it includes are constructed nearly upon the same model. The body is composed of a stomach possessing walls of its own, and suspended by vertical partitions which pass in a radiating direction between the outer surface of the stomach and the general integument, so as to divide the intervening space into numerous chambers. The stomach is closed at the bottom, as are also the surrounding chambers; and this is equally the case in the compound species as in the solitary. The radiating partitions have openings, by which the chambers communicate with each other · and there is also a free passage from them into the hollow tentacula, which are provided with orifices at the extremity, that can be opened or closed by the animal. Water is sometimes taken in by these orifices, so as to distend the radiating chambers and the tentacula; and is then ejected with considerable force through the same apertures. There is reason to believe that this is a respiratory process; the whole interior of the chambers, into which the water is received, being covered with vibratile cilia. These chambers, however, are specially intended for the development of the ova. The ovaries form plaited masses, attached along the inner border of some of the vertical leaflets which do not extend as far as the stomach. The ova appear to be developed in the substance of these masses, and to escape, by the rupture of the membranous envelope of the ovarium, into the interseptal spaces. The embryo is sometimes discharged through the tentacular orifices, as a mere "gemmule;" but it is not unfrequently retained within the body of the parent until it has undergone a further development, and acquired a stomach, mouth, and tentacula of its own. Young *Actiniæ* in this condition seem to be discharged, not by the tentacular orifices, which are too minute to give them passage, but by the mouth; although the manner in which they pass from the ovarial chambers into the stomach is yet an unsolved mystery. Besides the ovaria, these radiating chambers contain numerous long convoluted tubuli, which are believed to be the male organs. According to some, however, the sexes are distinct.

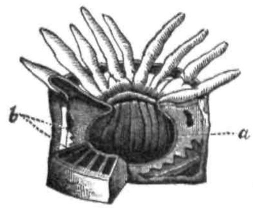

Fig. 13.—Section of Sea-Anemone; *a*, cavity of stomach, *b* surrounding chambers.

The *Actiniæ* proper do not usually increase by gemmation; but this mode of increase has been observed by Sir J. G. Dalyell in one species, from the expanded base of which small portions occasionally detach themselves, which subsequently become perfect *Actiniæ*. In numerous other species of the order we meet with some form of gemmiparous production, which gives rise to compound structures, resembling those of the other polypes, but usually much more massive. Thus in the *Zoanthus*, we find animals that agree with the Actiniæ in their general organization, springing from a common base, which is sometimes broad and flat, but more commonly a sort of creeping stem. In the arborescent species with a stony axis, however, the multiplication of the individual polypes of the compound mass seems to take place by the *division* of the bodies of those already existing, very much after the manner of the Polygastric Infusoria (page 708). The polypes of these compound masses are connected by a sort of gelatinous flesh; but this would not seem to have the same degree of organization as that of the *Alcyonian* Polypi; and there is no communication established between the digestive cavities of the individual polypes, by means of a system of anastomising canals, as there is in the group next to be described.

All the Corals which are distinguished as *lamelliform*, are formed by Helianthoid polypes; deriving their character from the deposit of stony matter, not merely in the bases of the animals, and in the substance of the gelatinous flesh that connects them, but also in the radiating partitions around the stomach. If the stony mass be the product of a single animal, as in the *Caryophyllia* or *Fungia*, it is marked on its upper surface by a single series of these plates (Fig. 14), strongly resembling the gills of the mushroom; but if the coral have been the axis of a compound mass, the radiating lamellæ will be seen in every one of the individual polype-cells (Fig. 15), which are sometimes very numerous and minute, especially in the Madreporidæ. These cells are not by any means constantly circular; but still the laminated plates project inwards from their circumference towards a common centre. Sometimes a number of cells unite into a groove or furrow; as in the *Meandrina* or brain stone coral. In all these cases, the stony structure is produced by the consolidation of the lower and older portion of the animal, by means of a deposit of carbonate of lime, whilst the softer or membranous portion undergoes a corresponding extension above. The stony axis, and its lamellated cells, are thus really parts of the animal structure, and *grow* instead of being *built up* by the agency of the coral polypes. The portion which has undergone consolidation, however, although continuous with the

Fig. 14.—Caryophyllia.

Fig. 15.—Mass of Astræa Viridis; *a*, *a*, expanded Polypes; *b*, *b*, Polypes withdrawn into their cells; *c*, stony mass uncovered by flesh.

soft tissues of the animal, no longer participates in its vital operations, and may be almost said to be dead; in fact the gelatinous flesh is frequently withdrawn from the lower part, so that it remains as an inert stony mass, whilst the upper portion is actively growing. In some of the arborescent corals (*Madrephyllidæ*), the stony matter appears to be entirely deposited in the substance of the polypes themselves; which are seated only at the *extremities* of the branches; but in the more massive species (*Madreporidæ*), it is deposited also in the connecting gelatinous flesh, and the polype-cells are scattered over the entire surface.

The Order may be divided into the following families :—

Section A. Body coriaceous or fleshy.

Family 1. *Actiniadæ*. Polypes separate and single.

Family 2. *Zoanthidæ*. Polypes gemmiparous, and associated by a common base.

Section B. Body secreting a calcareous polypidom.

Family 3. *Madrephyllidæ*. Coral with terminal cells.

Family 4. *Madreporidæ*. Coral cellular throughout, the cells connected by a calcareous network, their own walls also being porous.

All those massive corals, to which the formation of coral reefs and islands is chiefly due, belong to the second section of this order; and most of them to the family *Madreporidæ*. Whilst the animals of the first section are abundant in nearly all latitudes, those of the second are at present almost entirely restricted to tropical seas. The large amount of coral limestone, however, found interposed amongst various other stratified rocks, from the oldest even almost to the most recent, shows that they must have formerly had a much more extensive distribution. Only one small species (*Pocillopora interstincta*) belonging to the third family, and three (*Turbinolia borealis, T. milletiana, and Caryophyllia Smithii*) belonging to the fourth, have been until recently known in British seas. At the last meeting of the British Association, however, Mr. Mac Andrew announced the very interesting discovery of a living *Fungia* dredged up off the coast of Zetland.

ORDER III.—ASTEROIDA.

This division receives its designation from the star-like appearance of the short thick tentacula, six or eight in number, when expanded around the mouth. These tentacula are unprovided with cilia; but a number of little projections may be seen along their margins, which probably increase their prehensile power. The mouth leads to a stomach, which is suspended in the midst of the general cavity of the body by partitions radiating from its walls; the number of these partitions, and consequently that of the chambers surrounding the stomach, being the same with that of the tentacula. Instead of being closed at its lower extremity, however, like that of the Actiniform polypes, the stomach of the Alcyonians opens into the canals that ramify through the fleshy mass in which they are imbedded; the orifice being surrounded by a circular muscle or sphincter, by the actions of which it may be expanded or entirely closed. The chambers which surround the stomach communicate above with the cavity of the tentacula, each of which has a small orifice at its extremity; whilst below they are continuous with the ramifying canals just mentioned; and the membranous septa which support the stomach do not cease at its lower extremity, but are prolonged downwards as plaits or folds of the lining of these canals, until they gradually disappear. Here, too, the life of the individual polypes is subordinate to that of the general mass; and it is from the latter that all the extensions of the fabric by gemmation take place. On the other hand, the ova are developed in the substance of the membranous folds, and make their way outwards through the mouth.

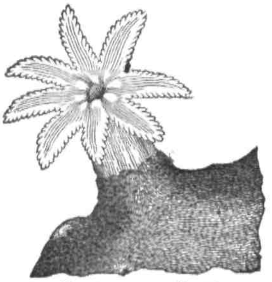

FIG. 16.—ALCYONIAN POLYPE.

In this order we find a remarkable diversity in the character of the polypidom, together with a great general similarity in the structure of the polypes themselves. It contains no solitary species; and the essential character, by which it is most distinguished from the Helianthoida, is the intimate connection of the individuals of the same mass. In the common *Alcyonium*, the polypidom has something of a *spongy* texture; being composed of a gelatinous flesh burrowed by a network of canals, and strengthened by a multitude of spicules of mineral matter, which form a sort of loose skeleton that extends throughout the mass, especially strengthening its surface. In the *Tubipora musica*, or organ-pipe coral, the external integument of each polype is completely consolidated into a calcareous tube. On the other hand, in the *Red Coral*, it is the centre which is thus hardened forming a very dense stony axis, on the smooth surface of which not a vestige of polype-cells can be detected This axis is clothed in the living state with a gelatinous flesh that is channelled out, like that of the *Alcyonium*,

FIG. 17.—ALCYONIUM; A, portion enlarged, showing the Polypes.

by the canals which connect the stomachs of the polypes imbedded in its substance. In the *Isis Hippuris*, the stem has a jointed character, being composed alternately of calcareous and of horny matter. And in the *Gorgonia* (Sea-Fan) and *Antipathes* (Black Coral) it is altogether horny; the investing substance, however, being furnished with a large number of spicules, forming a friable crust, in which the orifices for the polypes may be frequently discerned, when dried upon the horny axis. In some few cases, instead of being attached by roots to fixed bodies, the *Alcyonian* polypidoms are free, being carried about by the action of the waves and currents of the ocean. This is the case with the *Pennatula*, or sea-pen, and with the *Veretillum*, which is nearly allied to it (Fig. 14).

FIG. 18.—RED CORAL.

The order may be subdivided into the following families:—

Section A. Polype-mass fixed.

Family 1. *Alcyonidæ*. Polype-mass coriaceous or somewhat carneous, without any distinct axis, but strengthened by variously-disposed calcareous spicula; polype-cells subcutaneous, scattered over the surface.

Family 2. *Corallidæ*. Polype-mass arborescent; polypes scattered over the whole surface, imbedded in a thick cretaceo-gelatinous celluliferous crust; the axis solid, horny, or calcareous.

Family 3. *Tubiporidæ*. Polypary composed of calcareous tubes, arranged in successive stages; polypes terminal.

Section B. Polype-mass free.

Family 4. *Pennatulidæ*. Polype-mass pennated, carneous; the skin spiculiferous; the axis bony, simple, continuous; polypes arranged along a part only of the polypary, of which a portion is sometimes embedded.

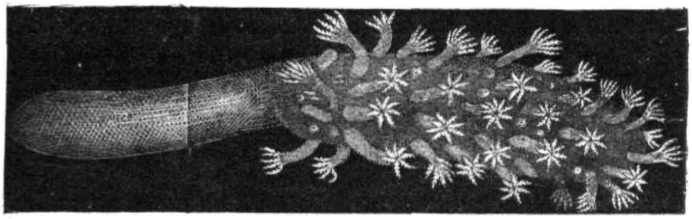

FIG. 19.—VERETILLUM

In order to bring the enumeration of families and genera contained in the text into harmony with modern views, the following table of Cuvier's arrangement, showing the real situation of each principal group, may be useful.

Order I.—CARNOSI; *Actinia*. *Lucernaria*.	Order II.—HELIANTHOIDA; Fam. 1 and 2. *Actiniadæ* and *Zoanthidæ*.
Order II.—GELATINOSI; * *Hydra*.	Order I.—HYDROIDA; Fam. 1. *Hydraidæ*.
Order III.—CORALLIFERI.	
Tubipora.	Order III.—ASTEROIDA; Fam. 3. *Tubiporidæ*.
Tubularia.	Order I.—HYDROIDA; Fam. 2. *Tubularidæ*.
Sertularia.	Order I.—HYDROIDA; Fam. 3. *Sertularidæ*.
Cellularia.	BRYOZOA of various families.
Corallina.	Belong to the Vegetable kingdom.
Ceratophyta.	Order III.—ASTEROIDA; Fam. 2. *Corallidæ*.
Lithophyta,—Isis, &c.	Order III.—ASTEROIDA; Fam. 2. *Corallidæ*.
Madrepora.	Order II.—HELIANTHOIDA; Fam. 3 and 4. *Madrephyllidæ* and *Madreporidæ*.
Millipora.	Chiefly BRYOZOA of various families.
Pennatula.	Order II.—ASTEROIDA; Fam. 4. *Pennatulidæ*.
Alcyonium.	Order II.—ASTEROIDA; Fam. 1. *Alcyonidæ*.
Spongia.	PORIFERA.

* Of the genera associated by Cuvier under this order, *Coryne* is the only one that is really allied to Hydra; *Cristatella* being a Bryozoon; *Vorticella* being an Infusory Animalcule; and *Pedicellaria* not being a separate animal, but an appendage of certain Echinodermata.

CLASS PORIFERA.

THERE can be no question that, if the Sponges and their allies be admitted into the Animal kingdom, they must form a distinct group, below the class of Polypes. Not only is the *radiated* disposition of parts altogether wanting, but even that definiteness of form is absent, which so peculiarly distinguishes the higher groups of Animals from the members of the Vegetable kingdom. The internal structure is no less deficient in Animal characters. There is no stomach or digestive cavity for the reception of the food,—no nervous system or organs of sensation and locomotion,—and nothing beyond the very simplest apparatus for reproduction. No movements of a decidedly animal nature can be observed in them; the gradual change of form of the orifices of the canals, which is sometimes witnessed, having at least an equal resemblance to the movements of many Plants: neither is there any decided indication of the presence of sensibility. Perhaps the strongest argument in favour of their animal nature is to be found in the resemblance of their structure to the general mass of *Alcyonia*, which may be likened to a sponge with polype mouths; and it is an interesting fact that, in the extension of these structures, the spongy mass is the part first produced, the polypes not appearing upon it until a subsequent period.

The exterior of every Sponge is covered with minute orifices or *pores* (whence the name of the class), thickly set together; and between these are seen the larger openings or *vents*, which, if traced downwards into the substance, are found to be the mouths of large canals or vessels that ramify through it. The pores open into a less regular arrangement of tubes and minute cavities, of which the spongy mass is principally composed; these freely communicate with one another throughout the mass; and the canals arise from the midst of them, by small tubes which unite into larger ones, these again meeting to form the wide channels which terminate in the vents. Through these canals, in the living Sponge, a constant stream of fluid issues forth; the supply being kept up by absorption through the pores. The cause of this movement is unknown. From these vents also issue forth the reproductive *gemmules*, which are minute ciliated gelatinous bodies, resembling Animalcules. They are first seen as minute opaque yellow points, irregularly distributed in the gelatinous substance of the body, and usually at some distance from the surface. As their development proceeds, they project from the walls of the canals into their cavities; and at last become altogether detached, and are carried forth by the current.

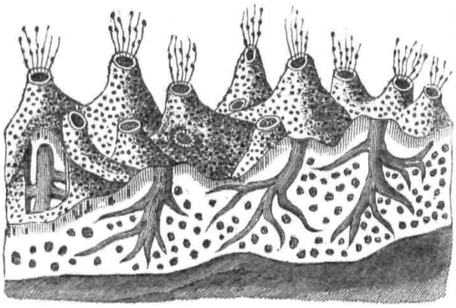

FIG. 20.—SECTION OF LIVING SPONGE.

The substance of the Sponge is chiefly composed of tubular fibres of a horny character, which form a network that possesses considerable elasticity; this network forms, as it were, a skeleton, which is clothed with a gelatinous flesh. In the greater proportion of Sponges, it is strengthened by spicules, or needle-shaped crystals of earthy matter; these, which are sometimes composed of silex, in other cases of carbonate of lime, are disposed at intervals throughout the mass; but are especially abundant in the neighbourhood of the canals, and around the external orifices both of these and of the pores, each of which is strengthened by a regular framework of spicules.

No classification of Sponges that has yet been proposed is likely to have a permanent value; so little being yet known of their real nature, and of the characters which should serve as the guide in their systematic arrangement.

CLASS INFUSORIA.

THE improvements recently made in the Microscope, and the large amount of attention that has been devoted of late to the natural history of this class, has vastly added to our knowledge of it. One result, however, of this increase of knowledge, which is mainly due to the researches of Professor Ehrenberg, has been to show that the two groups of which the Cuvierian class consists are really very distinct from one another, resembling each other in nothing but their minuteness of size, and the softness and

transparency of their textures; and that the order Rotifera ought to constitute a separate c.ass, and to have a place in the Articulated series.

ROTIFERA.

The animals of this class have usually an elongated form, and are perfectly symmetrical on the two sides. At the anterior extremity, we observe one or more rows of vibratile cilia; these are frequently arranged (as in the common *Wheel Animalcule*, Fig. 21, *b*), in a circular manner, and when they are in motion, an appearance of revolving wheels is produced, from which the class derives its appellation. In many species we find a prolongation of the body in front, extending beyond the ciliary apparatus · this, which sometimes bears one or more red spots that are supposed to be eyes, may be regarded as a head (Fig. 21, *a*). The body is covered with a double envelope, both layers of which are extremely thin and flexible in many species, whilst in others the outer one seems to possess a horny consistence, and may even contain siliceous matter. In the *Stephaniferos Eichornii*, this is so far detached from the body, as almost to form a sort of polype-cell, like that of the Bowerbankia; and the cilia, instead of being disposed in circular rows, are mounted on arms like those of a polype; so that the whole animal bears a strong resemblance to the Bryozoa, with which it forms the connecting link.

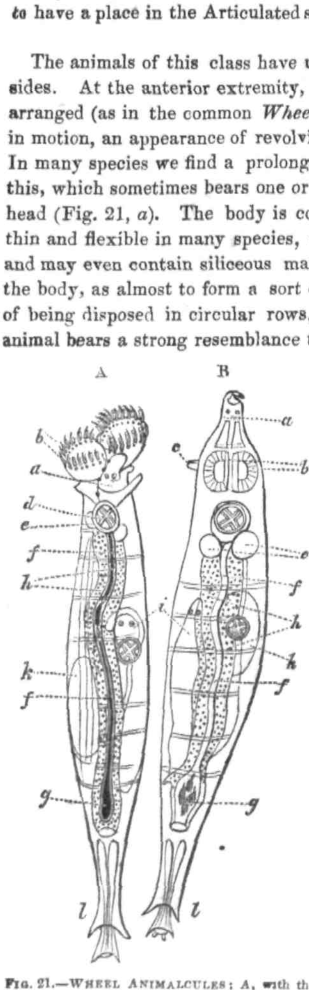

FIG. 21.—WHEEL ANIMALCULES; A, with the wheels expanded; B, with the wheels folded up and drawn in; *a*, the head with the eye-spots; *b*, the wheels, *c*, water-siphon; *d*, masticating apparatus; *e*, salivary glands, *f f*, intestinal canal; *g*, its dilated termination; *h*, glandular apparatus surrounding it; *i*, young ones nearly complete; *k*, eggs; *l*, tail.

The body of the *Rotifer vulgaris* not being enclosed in any such dense envelope, is capable of considerable extension, and has much of the Vermiform aspect; this is increased when a slight contraction draws the external membrane into transverse wrinkles, that seem to indicate the segments of the trunk. The posterior extremity is prolonged into a tail, possessing three joints, which can be drawn up within each other. Within the external integument there are four longitudinal bands running from end to end; these are probably bundles of muscular fibre, by the contraction of which the body may be shortened. On the under surface of the head is a projecting orifice, which is believed to act as a syphon for the introduction of water into the general cavity for the purpose of respiration; the ciliary movement being destined to bring food to the mouth, which is situated between the wheels. The wide œsophagus terminates in a sort of gizzard (*d*), provided with regular teeth at its entrance. These teeth are two in number on each side, and are fixed upon hard jaws, moved by powerful muscles, so as to work between each other. All the food which is swallowed is submitted to their action, before it enters the first stomach, and when the cilia are in operation, these jaws are always in regular movement. From the first stomach or gizzard there passes off, in the Rotifer, a long straight intestine (*f f*,) which terminates without any dilatation except near its close at *g* just at the commencement of the tail; this tube is surrounded by a glandular apparatus, *h*, which may be regarded as a liver. In many other Rotifera, however, we find the gizzard opening into a larger cavity, which may be regarded as the true digestive stomach. Near the termination of the intestine is the oviduct, by which are extruded the eggs, *k*, which are formed in the large ovaria. Besides the longitudinal muscular bands, transverse lines may be observed to cross the body at intervals, which are believed by Ehrenberg to be blood-vessels, passing off from a trunk that runs along the back, like the dorsal vessel of Insects. A distinct nervous system unquestionably exists in the Rotifera; though it cannot be seen in the *Rotifer vulgaris* so clearly as in some others of the group.

The movements of these animals are very active and varied. Sometimes they attach themselves by the tail, and set their ciliary apparatus in motion for the purpose of obtaining food; in which condition they bear a strong resemblance to Bryozoa. But they also swim freely about through the water, the ciliary apparatus being folded up (as in Fig. 21, B), and they then resemble aquatic Worms. And sometimes they crawl along a solid surface, after the manner of a Leech. Yet with all this complex organization and these active powers, many Rotifera may be completely dried up, and preserved for an

indefinite period, without the loss of their vitality; being revived again by moisture, and returning to their original activity.

The reproduction of the Rotifera is not accomplished by gemmation, nor by the subdivision of the body, but only by eggs. Of these, not many are produced at once; they attain a large size in proportion to the body of the parent (Fig. 21, *k*); and the development of the embryo often proceeds so far before the egg is extruded, that its ciliary movements are visible. The egg-capsule frequently bursts when the egg is passing forth, so that the young may be said to be born alive; being capable of active locomotion, and of obtaining its own food, as soon as it quits the body of the parent. Notwithstanding that the number of eggs undergoing development at one time seldom exceeds three or four, the reproductive powers in this tribe are very extraordinary, in consequence of the rapidity with which the young arrive at maturity, and become the parents of a new generation. From the observations of Professor Ehrenberg on the rate of propagation of the *Hydatina senta,* one of the largest of the Rotifera, he calculates that, from a single individual, more than a *million* might be generated in *ten* days, and nearly *seventeen millions* in *twenty* days. This rapidity of multiplication, taken in connection with the power which these animals possess of being revivified after entire desiccation, is quite sufficient to account for their sudden appearance in various situations in which they were not previously known to exist, and for their extraordinary abundance whenever the conditions in regard to food, temperature, &c., are favourable.

The class is subdivided by Professor Ehrenberg in the first place, according to the arrangement of the ciliary apparatus, into two sections, each of which contains two orders; and every one of these four orders is subdivided into two families, according as the external skin is soft or naked, or forms a dense *lorica* or sheath.

Section A. Monotrocha. A single, continuous, ciliated wheel.
- Order I.—Holotrocha. Margins of the wheels entire.
  - Family 1. *Icthydina.* Skin naked.
  - Family 2. *Œcistina.* Skin loricated.
- Order II.—Schizotrocha. Margins of the wheels crenated.
  - Family 3. *Megalotrochæa.* Skin naked.
  - Family 4. *Floscularia.* Skin loricated.

Section B. Sorotrocha. A compound, or divided, ciliated wheel.
- Order III.—Polytrocha. Many-parted wheels.
  - Family 5. *Hydatinæa.* Skin naked.
  - Family 6. *Euchlanidota.* Skin loricated.
- Order IV.—Zygotrocha. Two-parted wheels.
  - Family 7. *Philodinæa.* Skin naked.
  - Family 8. *Brachionæa.* Skin loricated.

HOMOGENEA.

This group is now more commonly known under the name Polygastrica, conferred upon it by Professor Ehrenberg, from the idea that the animals composing it are distinguished by the possession of numerous digestive sacs or stomachs. In this view, however, many very competent observers are far from coinciding; and the previous designation may, therefore, be properly retained, until the organization of these beings shall have been more fully ascertained, and their true relations shall have become more completely apparent. At present there is a strong tendency to transfer a large proportion of them to the Vegetable kingdom; it being now certainly known that an active movement, occasioned by the vibration of cilia, is visible in many of the humbler Plants; so that the power of thus making its way through water, even with considerable activity, is by no means that certain and distinctive attribute of an Animal, which it was at one time supposed to be. Moreover, it is certain that many of them are allied to Plants in their chemical constitution, and also in their power of growth and increase under the influence of light, at the expense of water and carbonic acid merely. It has lately been ascertained, too, that the *Desmideæ* and *Diatomaceæ* reproduce themselves by *conjugation*, after the manner of the Zygnemata, which are undoubted plants; so that, although these are described and represented by Professor Ehrenberg as Infusory Animalcules, they are now transferred by most Naturalists to the Vegetable kingdom. It seems not improbable that a large proportion

of the group will have to undergo a similar transference; but it would be premature to attempt the separation at present.

The forms presented by these Animalcules are extremely various. In some we can scarcely detect any definite shape; their bodies appear composed of a mass of gelatinous matter destitute of any solid support, which may project itself into almost any figure. In others there is still a considerable variety in the forms assumed by the same individual under different circumstances (Fig. 626, *d*); but still a prevailing shape can be recognized. In others, again, the body, although still unprotected by any firm envelope, appears to undergo little change in figure, except when affected by temporary pressure. But there are many species which cannot be influenced even by this; their soft bodies being enclosed in a delicate but firm integument, strengthened by a deposit of siliceous matter. These are termed *loricated* Infusoria; and their envelopes are often preserved after the death of the Animalcules, accumulating by their multiplication into vast masses. In these loricated tribes, however, were included many forms now transferred to the Vegetable kingdom.

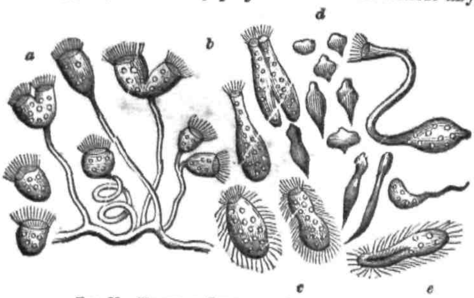

FIG. 22.—VARIOUS FORMS OF ANIMALCULES.

Those seem most entitled to the designation *Animalcules*, which have a distinct *mouth*, surrounded by vibratile cilia. By the agency of these cilia, food is taken into the cavity of the body; and refuse matter is sometimes expelled through a separate orifice. When these Animalcules have been allowed to remain for a short time in water, in which finely-divided particles of colouring matter are suspended, the whole of the transparent body is seen to be studded with coloured globules of a tolerably uniform size, each of them composed of an aggregation of particles.

From this class of facts it has been inferred by Professor Ehrenberg that a large number of globular cavities exist in the substance of the body, into which the food is received; and he considers that these all sometimes communicate directly with the mouth; but that in general they are arranged along an intestinal tube, into which they open by a short neck. Notwithstanding the high authority, however, which Prof. E. has acquired from his patient and long-continued study of these Animalcules, this doctrine has not received very general assent from those most competent to judge of its merits, being regarded as rather an hypothesis founded on observations, than as itself entitled to rank as an observed fact.

It is to the action of the vibratile cilia, also, that the great variety of movements exhibited by these beings is entirely due; and this fact would seem to indicate that these movements are not directed by consciousness. No organs of sensation have been shown to exist in this class of Animalcules; nor has any indication of a nervous system been discovered.

Several modes of propagation are seen in this class of Animalcules. Not unfrequently we observe a reproduction by the development of *gemmæ* or buds, as in the *Vorticella* (Fig. 22, *a*); but in other species the multiplication is effected by the separation of the body into two parts, the division sometimes taking place longitudinally, as at *b*, sometimes transversely, as at *c*. This process takes place with such rapidity under favourable circumstances, that it has been calculated that from a single *Paramæcium* (Fig. 22, *e*), no fewer than 268,000,000 might be produced in a month. In other tribes, however, propagation takes place by ova or germs evolved within the body of the parent, the greater part of whose bulk is often made up of them.

When the gemmæ remain adherent, instead of becoming detached, compound structures are produced, more or less resembling those of Zoophytes in miniature. The groups of *Vorticella* are examples of this; but a still more remarkable instance is the *Volvox*, formerly designated the globe-animalcule, but now known to be composed of a congeries of Monads produced by gemmation from a single individual, and invested by a common envelope.

The classification of this group proposed by Ehrenberg is principally founded on the various forms under which he believes the alimentary canal to exist in them; and until the existence of these shall be generally admitted, the classification cannot be regarded as having any permanent value.

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